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EDITORIAL NOTES.

Meeting of the Institution of Gas Engineers.

CROWNED by the success of the past week's meeting, the occupancy by Mr. R. G. Shadbolt of the highest honorary office in the gas industry has come to an end; and he carries away with him into the normal course of work for his Company and for the gas industry, a wealth of respect, congratulation, and obligation from the gas profession and the gas industry generally. No man could desire more; and no man could obtain more, however high his professional rank. Mr. Shadbolt has been an exemplary President. He has had, it is true, exceptional opportunities during the year; but these opportunities have been of a kind that has meant additional arduous and anxious work for the head of the Institution. The President met the increased work with a conscientiousness and seriousness that disclose his views as to the obligations that repose about the chair of the Institution. The responsibilities of the President of the chief organization were never greater than they are in these times; and these responsibilities will not brook any perfunctory demeanour. They have been scrupulously regarded during the twelvemonth; and the results now form part of our industrial history. Dignity, courtesy, tact, and geniality have markedly characterized the doings of the President throughout the year; the same characteristics were constantly present in the conduct of the proceedings of the past week—whether during the business or technical parts, or when the President and Mrs. Shadbolt were the hosts at a brilliant entertainment, or when the President was at the head of those who took part in the highly enjoyable visit to Cambridge, and voiced the indebtedness of the visitors to the University authorities, and the Chairman and Directors and Engineer of the Gas Company for their kindness. The personal tribute is more than warranted.

The ordinary meetings during the week, and the special conferences in the afternoons, conspicuously show that in the contemporary political affairs of the gas industry (of which there is an unprecedented crop at the present time), there is a mass of material which alone, without set papers, provides much debateable matter. And the discussions on such matters as the attack of the chemical manufacturers upon the residuals trading of the industry, the framing of a street-lighting specification, stove and tar prices, the allowance for depreciation in respect of income-tax (away from the meetings, too, discussion was going forward with the authorities as to the position of gas-works' employees under the unemployment section of the National Insurance Act), all indicate how interest is expanding among the responsible workers of the industry in these political questions. Their increase is a sign of the times; and their increase forces upon us the necessity for the best available machinery for dealing with them. Partly due to the consideration of certain of the subjects enumerated, is the fact that the time at disposal for the discussion of the papers had to be allocated as judiciously as possible. It was thought by some soothsayers prior to the meeting, when the papers had been seen, that there would be no difficulty in this respect on the present occasion. But as events proved, one or two of the papers were tactfully relieved of discussion; while in the case of others which were fairly well discussed, the iron rule of the "closure" had to be applied in order to make room for the succeeding papers or business. After previous experiences, it is time that a change was made from the conventional lines of conduct of the meetings; and to this end, at the instance of Mr. Harold E. Bloor, the matter has been referred to the Council for consideration and report. The courses at present suggested are that papers should be taken as read (which would confine discussion to those members who had been sufficiently interested and diligent to give them prior study), or, alternatively, abstracts should be prepared for reading. By one or other of these means, there would be no need for the meetings to further encroach upon the hours of the few days that the members of the gas profession and their ladies from all parts of the kingdom are able to annually meet together. Clear it is that something must be done to economize time at the meetings.

Among the general matters discussed on the first day of the meeting was the attack of the chemical manufacturers upon the liberties of the gas industry in the matter of legitimate free-trading in residual products. If the Parliamentary authorities had been present, they would have heard the question discussed dispassionately by men who are determined not to take lying down the intolerable injustice that has been done, and is still being done, in not the public interests, but in the interests of the powerful and wealthy chemical manufacturers. They would have heard, too, something of the commercial tactics of the chemical manufacturers, who are using Parliament to obtain a still stronger grip over the secondary business of gas undertakings, to their own commercial advantage, and to the disadvantage of the gas industry and the large public that it serves with an indispensable commodity. We invite the Parliamentary authorities to read the discussion at the meeting; and they will see how the instances of commercial oppression that can be quoted will extend under the limiting rule that, without adequate investigation, has already been imposed on several gas-supplying concerns. The chemical manufacturers are astute men; and in this matter, unfortunately, they have scored a success repugnant to our legislative principles. But the protest and the contest over this matter have not finished. There is more to come; and the Council of the Institution have received from the members a mandate that gives them free action in the matter. The Council must, however, be fully armed. It is understood from the President that, in response to the circular of inquiry sent out, some 700 replies have been received; and some very valuable evidence has been accumulated, which is to form an important part in the case of the gas industry against this miscarriage of justice. Those who have not responded to the circular are requested to do so, and especially to quote any cases of commercial oppression arising from the present condition of things. What happens now is an index to what will happen of a vastly larger order if the doors of free trade are closed in respect of residual products. To keep them open is the only way of assuring fair prices in the future, and better prices for small gas undertakings.

That, however, is only one matter issuing from this highly successful meeting. What of the future? The year 1913 is the Jubilee Year of the Institution; and on this occasion of celebration, the gas profession have elected their acknowledged leader to the chair of the central organization. The gas profession are honoured by the acceptance of the duties of the year by Mr. Woodall; and Mr. Woodall himself feels deeply the distinguished honour that the gas profession have done him. Through his position in connection with Parliamentary affairs, through his high position in gas administration work, no one has greater knowledge than Mr. Woodall of the growing responsibilities of the President of the Institution; no one knows more than he the importance for the future of (in the present) tactful and diplomatic direction of the industry's current affairs. But the fact of additional responsibility in this regard has not deterred him from responding to the call and desire of his professional colleagues; and therefore the more will his response be appreciated throughout the industry. So far as the celebration of the Jubilee Year is concerned, the right President is the initial step to the assurance of success. But beyond this he must receive, and to a considerable extent, the support of the profession and the industry. One manner in which this can be rendered by gas undertakings is in at once sending in their names as subscribers to the Guarantee Fund for the Gas Exhibition of next year. The preliminaries must be completed early; and upon the preliminaries, which include the establishment of a good Guarantee Fund, depend the whole character of the Exhibition. The Exhi-

bition must show to the United Kingdom the gas industry's position in the service of, and the capacity to further serve, the public. All this, however, applies to the future, though demanding immediate consideration. Let us now return to the proceedings of the past week from which these matters arise.

The Lines of Development.

The Presidential Address was a composition apart from all else at the meeting. It has, and particularly so on this occasion, an individual place of its own; and, hearing it or reading it, the spirit of the many thoughts to which it gives expression, and which all tend to the same end, quickly takes possession of one. In it the President looks around upon our industrial affairs with a characteristically clear and sharply perceptive eye; and he takes us from point to point with unerring lead, until we get, in comprehensive view, the wealth of the industry's many opportunities, and which opportunities beckon everyone executively concerned in the industry to move forward, as only by so doing can we do each our part in contributing to the strength of the industrial edifice, and in making it proof against the sterner assaults that time threatens it with. "What is our present "task as true engineers?" asks the President in the closing words of his address. He himself replies that it is, "in the "widest sense so to design, so to build, and so to construct, "that the superstructure which others will base upon our "present labours may prove one of enduring strength, of "extreme utility, and of the greatest adaptability." Loyalty to the industry, loyalty to themselves and to trust, demand that all shall work thus, viewing not only the present, but unselfishly the future. The work of the present, as in the past, and as it will be in the future to those who succeed us, is to keep the line in the process of expansion.

We take credit for the technical and other executive officers of the present in the industry, and for all other participants in the responsibilities and duties associated with the industry, for having done their part in its constructive work—technical, commercial, and utilitarian. For if they had not done so, the opportunities that are unfolded in the address would not have been capable of being so clearly defined. The taking of opportunities generates fresh ones; and so the process of evolution proceeds, and even greater prosperity—measured by economic or financial standards, or by the degree of stability—is engendered. In all this, the technical side must dominate the commercial side of our industry, though both are interdependent, and the one promotes the other. The President dilates upon the importance of the "engineering" side of the industry; and no one can deny it that engineering is more than ever the basis of all successful operation, though the engineer is not always the creator of the work which supplies him with the ground for the exercise of his talents. However, in the gas industry, the chief officer has to be something more than is commonly connoted by the term "engineer." The President himself indicates the varied essentials in qualification that the so-called "engineer" must incorporate within himself to adapt him for the control of an undertaking of such varied character as the producing, distributing, and selling of gas and much else. We almost seem to want a new and fitting title for a man whose attainments must exceed those of an engineer for the proper performance of his official functions. Engineering admittedly takes the premier place in the fundamental technical work of the industry; but after engineering, this technical work means something more, and of day-to-day importance. Therefore, we would look at the fundamental part of the work of the industry in a broader light than is possible if we view it only from the purely engineering standpoint. We want to get away from the restricted idea of the chief technical official being solely an engineer; it is rather apt to do harm by suggesting to the prospective technical officer a too narrow definition of his duties.

The very fact that the technical officer must possess such varied qualification for the due and adequate performance of the duties of his position shows the scope and fertility of the industry itself, and thus the growing scope there is in it for the most brilliant abilities. The expansion of the scope of technical and other affairs in association with the industry also necessitates the *pari passu* expansion of the knowledge of the technical officer; and the expansion of demands in the matter of the application of his products requires that he shall be capable of adapting himself to the circumstances of changeful time. The address proceeds to show how the developments of the work of the industry in its every part, technical and commercial, perfectly fit in one with the other—the technical with the commercial, and the commercial with the technical. Nothing could have been happier than this mutuality in development. We have this exhibited in the President's references to the quality of gas that is required to-day, to the thousand-and-one present uses of gaseous fuel, and to the large prospective developments in use that day-by-day assume more definite shape before our eyes. Over all which stands prominently the fact that plant and technical practices in carbonization have taken the line in development that produces the gas having the requisite qualities for the new applications in a manner that presents to gas maker and consumer an over-all economy and efficiency never before attained in the history of gas manufacture and supply. This being so, no need arises to talk much of the difficulties (the President does not do so—he merely presents the point as evincing the necessity for a ripe selective ability on the part of the technical officer) of appraising the relative value of the competing carbonizing processes for one's local conditions; for the very existence of a variety of systems contributes to the opportunities for still greater expansion. In this the industry is therefore on the right line. Furthermore, not only in carbonizing but in the processes of refining the crude gas to make it fit for the purposes of the day, work is shaping well to a revolution of method and to a displacing of the curious medley of practice that at present obtains. The President looks favourably upon the work proceeding in the direct removal of ammonia from the gas without the intervention of scrubbing plant. He mentions the work of Burkheiser; but the modified Feld process for the extraction of ammonia has a high testimonial given it, through the President, by Herr Kobbert, of Königsberg. In his case, the process has extracted practically all the ammonia from the gas treated; and the salt produced contains from 96 to 98 per cent. of sulphate of ammonia, and an ammonia content of 25·4 per cent. On such actualities, the President cannot avoid regarding as promising the work in this direction; and there is indeed reason to think that these processes will not remain at the incipient stage, but will find a large place among the practices of the future. Here, again, the character of the gas that is demanded to-day broadens the possibilities. So development succeeds development, and opens the gates to still further achievement.

The President could not touch on the subject of gasholders without giving voice from the chair of the central professional body to the opinion that it would be a misfortune to the industry if the spiral-guided—the most ingenious and rigid of gasholder constructions—were allowed to stand condemned in the minds of gas engineers on insufficient grounds. We hardly think it is in the minds of gas engineers where the danger of misjudgment exists. It is in the minds of less competent, and yet influential, judges where there are to be found the seats of danger. Enough said. The gasholder and distribution are wedded subjects, and so are distribution and higher pressures; and here, again, we have presented in the address how our modern industrial development gives new vitality and opportunity, and generally broadens the field. "Once," observes the President, "the initial pressure of gas delivered is placed "constantly above that required for all working purposes, "the first step towards an infinitely wider field of applica- "tion is taken." And it is a wide field! To attempt to enumerate the manifold purposes to which town-gas supplies are being, and will in the near future be, applied would, the President also observed, become wearisome. We rather think such enumeration would be almost impossible to-day, and, as the days pass, it will become quite so. But in respect of the lines of development, there must be a prudent reserve in passing judgment upon novel courses in development—such as surface combustion. More radical changes in process than this have passed from rudimentary stages to perfect utilities. Though we see the element of a personal doubt lurking beneath the President's phrases on this subject, he is conscious of precedent in unexpected happenings as he writes words to this effect: A little patience is necessary to enable so great a departure from accustomed practice to find its bearings, and to allow the environments of the newcomer to adjust themselves. This adjustment is precisely what at any rate one important element in environment is doing, and that element is the gas itself, in regard to which work must be in the direction of removing restriction to this end as much as possible, and to resist to the utmost any new restriction that cripples

advance. We are almost sorry the President mentioned 550 B.Th.U. gross, for instance, as being ample for all present-day requirements. But he did so in conjunction with 15-candle gas, which safeguards those with 14-candle standards (or lower penalty ones) who may be contemplating a calorific test, or may have one placed upon them now in supersession of the illuminating power test. All the President's subsequent argument shows that a simplified constitution of gas is what has to be worked for, in meeting current and prospective demand. Let us cling to the idea of a maximum allowable freedom. The industry itself will work to its best interests, which are those of the consumer. The units of it that do not do so must go under, or fall into the rear.

The evidence that the President was able to produce as to progress of Sabbath rest in gas-works is alive with interest; and the ability to give the day is of the fruit of industrial progress. Where, under normal conditions, it cannot be given, there must be something radically wrong. This is the testimony of experience in hundreds of works to-day, where, except in abnormal times, the Sunday stoppage is the rule. A zealous advocate, too, is the President of the principles and practice of co-partnership on the lines so firmly laid by Sir George Livesey. All the information and all the advocacy in these connections are in the cause of justice, and of higher incentives where encouragement is badly wanted. Such policy in respect of labour contributes effectually to the freedom and to the expansion that are the keynotes of the address.

It is too much to hope that an industry under statutory rule can hope to go on without attempts being made to impose upon it new restriction other than that all-sufficient regulation that is enforced by competition and self-preservation. The President sees great danger for the residuals markets of the gas industry in what has been done in Parliament up to the change effected by the Swansea and West Kent Orders. Speaking from the chair of the Institution, the President warns Parliament that the inevitable result of what has been done, if persisted in, will be to effectually remove competition, and to fasten upon the gas industry a parasitic monopoly. This has been seen from the original movement by those who made any endeavour to penetrate action so as to ascertain possible effect.

Excepting for such impediments, the outlook of the gas industry is wide, the opportunities large. It is necessary to take advantage of them all, and not allow them to slip away. The modern methods of publicity have to be used conjointly with opportunity. Many things favourable to the fullest development are on our side; largely subscribing to which is the greater perfecting of co-operation between the representative organizations of the industry—the Institution, the British Commercial Gas Association, the Society of British Gas Industries, and the Gas Companies' Protection Association. The message of the President was: The industry has grand, and never better, opportunities. Take them in all their fullness; and maintain and further elevate the industry's proud position among the economic and productive services of the world.

The Papers Discussed.

THE papers on this occasion cannot be described as being either striking or controversial in character, though each one of them has inherent value both as to timeliness and the mode of treatment on the part of its author. The only engineering and constructional paper was that presented by Mr. S. Meunier, describing the development of the Portwood Gas-Works of the Stockport Corporation. It showed the wide range of extension and concentration work that has been carried out by the author; and it confronts us with a phase of the engineer's work that is all-important—that is, the ability to design to meet environment rather than to fit standard types and details to the environment. We find this ability throughout the paper. The greatest compliment that can be paid to the engineering work which Mr. Meunier has carried out at Stockport is to say that when, in almost any part of gas-works construction, an engineer is setting to work to design an extension, he should not fail, among other published descriptions of work, to consult this paper. Published descriptions of new works such as this are found to be of considerable use to engineers who are about to plan new works, or to execute extensions. They are often suggestive; and it is no disparagement of an engineer's own powers of initiative for him to also take advantage of wide experience by the exercise of selective power, or by obtaining inspiration from things that have been done before. Improvement is often effected in this way. Among the large variety of work described in Mr. Meunier's paper are found novel features and some difficult circumstances which had to be negotiated; and here we have illustrations of the power of adaptability. We cannot enumerate the points here. They are many; but several will be found in association with the carbonizing plant, and others in gasholder extensions, in purifiers, and in other directions. The table of the approximate costs of the extensions, having regard to locality and years, will, with the drawings, also be useful.

Comment on the papers by Mr. H. Townsend, on "The "Incidence of the Day-Load," and on those by Mr. J. H. Brearley and Mr. Thomas Glover on the Examinations in Gas Supply and Engineering is made in separate articles. Turning, however, to the other papers, the vastness of the industrial field for business in gaseous heating cannot be kept too prominently to the front of the administrative minds of the gas industry; and the communication read by Mr. A. W. Onslow assists in this desirable purpose. The purport of the paper, as has been that of all papers touching this live contemporary subject, is to show that, if we are to enter into the full possession of this land of promise, we must obtain for those who employ gas for heating purposes the maximum of economy by perfecting the details of their appliances, and endowing them with the maximum of efficiency. Obligation does not nowadays end with gas supply, if an undertaking is to be successful in all things commercial. Imperfect construction and detail of apparatus are frequently responsible for more waste in the old-fashioned modes of using gas in industrial operations than would, if saved, in the course of a short period, pay for a new equipment devised on scientific lines. On fuel costs alone, in metal melting and other work, Mr. Onslow calculates that gas at 2s. is about equivalent to solid fuel at 20s. But this comparison only covers part of the story in the economic bearings of gaseous heating in the industrial sphere. Prompt application, regularity of temperatures, rapidity of operation, increased output in relation to time and space, cleanliness, no need for preliminary fuel purchases and storage—all combine in promoting that important factor in industrial life and competition, works' economy. Like Mr. E. W. Smith at Birmingham, Mr. Onslow's experience is that working with high-pressure gas, with air at atmospheric pressure, he can regulate temperatures to any degree with such certainty that, under any given conditions, the ability is in his hands to produce, maintain, or reproduce any temperature desired. This means a permanent capacity for uniform work. Of course, for the lower range of furnace temperatures, gas at district pressures suffices. The paper is a distinctly useful one; for it confirms experience and supplements hints which all go to establish strength in the industrial department of the business of gas supply and application.

We are afraid that more academic interest than any real practical value to the gas worker is to be found in the description of a new laboratory method for the comparison of the coking properties of coal that Dr. Lessing has devised, but which has attractions for the investigator and student if used with discrimination—always bearing in mind that the inventor himself shows a judicious reticence in suggesting that the apparatus can be employed as an indicator of what is possible with coal under large-scale working conditions, other than in a comparative sense. Many people have long since discarded the laboratory 2·24 lb. test as being incapable of offering any real index of the product of a coal under daily working carbonization; and, therefore, how much more will they view with suspicion Dr. Lessing's 1 gramme test, however beautifully devised the apparatus, however constant and large the range at command of the electrically produced temperatures, or however perfect the ability to test coal under positively comparable conditions. This ability is really the side where the greatest value of the apparatus comes in. If it is desired to test a coal for its coking characteristics, to ascertain the physical properties and structure of the coke, as compared with that from any other coal, it can be done by the aid of this arrangement; should a running test be required on coal deliveries for their coking properties to ascertain that there is no variation in the raw material in this respect, if the fresh coal produces in this handy test apparatus the same characteristics in coke product as the previous delivery of coal, then it may be safely assumed that, under working conditions, the new coal will yield the same results as the former deliveries. Tests can also be made in the same way for information as to the volatile

products of coal. But the value appears to stop at comparison—comparison of one coal with another, or as a guide as to whether a coal will produce the same results in carbonization on the large scale as a previous coal that has been submitted to this new laboratory test. But there is danger in using the test as any reliable guide as to what a coal is capable of in large-scale working. The test, however, seems to possess greater usefulness, both for comparative purposes and for studying the properties of different coals, than its predecessor, the crucible.

Development of the Day-Load.

Both commercial and technical value attaches to the paper by Mr. H. Townsend on the "Incidence of the Day-Load"—a paper that discloses an amount of industry on the part of the author that the importance of the subject in the present day fully justifies. No one assesses the influence of the day-load in current times at a low value; but the critical thing is the adoption of methods and charges that shall be best applicable to any particular local circumstances. It is quite clear from the analytical investigation that Mr. Townsend has made of the day-loads, methods of cultivating them, prices charged, and, so far as he has been able to do so, the local conditions of a number of undertakings in Lancashire and Yorkshire, that there can be no universal standardization of either methods or charges. The conditions defy this; and management has to come into play, and the revenue account be the arbiter of the soundness of the policy pursued in the various directions. Mr. Townsend's figures show that, in the industrial centres of the counties named, the day-load varies anywhere between one-third and close upon one-half of the total output—reckoning the day hours as between 6 a.m. and 6 p.m. But the day-load is built up in varying manner by varying purposes; and therefore its incidence in relation to manufacture has likewise a varying significance. But look at the matter how one will, the day-load is something that is of economic importance to gas manufacture, to the consumers, and to the general well-being of an undertaking; and it is something that to secure has to be paid for, though not so dearly that it is a burden upon a concern, instead of a beneficial auxiliary. Without the day-load, in many towns, the consumers of gas for lighting would to-day be paying more for their supply than they are now doing, and yet a proportion of the day-load—that consumed for power and industrial purposes—is sold at prices considerably below those being charged to the lighting consumers.

We must not, however, place too great a weight upon some of the percentage figures given in the paper, as affording any reliable indication as to the spirit and wisdom shown in developing the day-load in different towns; nor must we place too much value upon them as presenting us with any dependable clue as to the influence of systems or prices. Local circumstances in regard to industry, population, and so forth place their limitations upon the application of the relation of consumption to systems and prices as a test of the efficiency of those systems and prices. Percentage figures, too, are oftentimes very deceptive things; and volume figures are frequently the more reliable. Take, for example, Mr. Townsend's remark: "It is rather surprising "to find that selling gas at very cheap rates does not neces-"sarily imply a heavy day-load. For instance, these tables "include the undertakings selling the cheapest gas in the "world, in one of which the day-load is 41·22 per cent., and "in the other 36·94 per cent." Without the actual volume figures before us, we cannot see that it necessarily follows that because the percentage day-load figures in these towns are not so high-pitched as in some other towns, that those figures are any reflection upon the "cheapest gas." If the cheapest gas has maintained the lighting load at a high level against the competition of electricity—as at Sheffield, for example—then we have a reason for the day-load rendered as a percentage being below that of some other towns where the higher prices and the competition of electricity may have caused the lighting load to shrink, or not advance in the same proportion as in the towns of "cheapest price." Hours of working in the local factories may likewise influence the poise one to the other of the day and night load figures. And to go still further, the variation of the hours of daylight and darkness during the year renders it impossible, through overlapping, to make any proper computations of the gas used for lighting and for other purposes.

Concerning the charges for the purpose of cultivating day-load for power and industrial operations, regard must be had to the matter from the competitive point of view. To the manufacturer, choice is much a matter of economy—not only in respect of fuel but of time—added to the value of convenience. This competitive aspect of the matter is one upon which Mr. Townsend does not lay so much stress as we think he ought to have done in considering the factors bearing upon the fixing of prices. Diplomacy has to be exercised, and expediency has to be taken into account, in this connection; and no exact rules in relation to either can be prescribed. It is conceivable that, in some cases of large business connections, it would pay to let a consumer have gas at a very low rate for a purpose that is most vulnerable from the competition standpoint, in order to retain his custom in other directions. It is sometimes difficult to recover business that is once allowed to stray away, when the new equipment is in and paid for. Most gas managers know, as we know, of works where electric motors perhaps have displaced steam or gas engines, and that the displacement has led to successful seductive offers to supply electricity for lighting at low rates. To save such business, diplomacy and expediency must come into action. Really, however we look at this matter of price for day-load, it is invincible against any universal systematized treatment. Every gas undertaking must look to its local conditions; every management must treat every class of business on its merits within the terms of its statutory powers. There are, of course, general principles that can be universally applied to the development of business. Mr. Townsend's investigations assure him that the concerns that adopt such commercial methods as advertising, combined with good displays and demonstrations at show-rooms, and that undertake the free maintenance of consumers' heating appliances, with inspection and regulation of engines, and such-like work, develop the largest day-load; the undertakings that do not practise these ways of modern commercialism are found to be at the bottom of the list in the matter of day-loads.

With Mr. Townsend's general conclusions or articles of belief in this matter, there is agreement, subject to modification if necessary in abnormal circumstances. There is no question that the day-load is largely a matter of locality and trade; and that it is highly desirable to foster it by all sound methods. As to the wisdom of giving substantial discounts for power and industrial purposes, there can be little discussion. Electricity, suction and producer gas, and oil are not ignorable factors in this determination; and it is no use affecting a disregard of them. As to the free supply or fixing at (apart from the gas sold) unremunerative rates of domestic appliances for developing the day-load, the accommodation is the equivalent of a discount; and therefore it is only fair to lighting consumers that the rate of charge should be equivalent to the lighting rate—providing, of course, that the lighting rate is not at such a figure that no one could afford to use gas for heating purposes at the rate. Circumstances, however, will and must always alter cases. In view of the present trend of affairs, flat-rates, in Mr. Townsend's case, are preferable to differential prices—of course, excepting power and industrial uses. A low flat-rate is the ideal policy—when it can be effected; but the attainment of the ideal again depends upon circumstances. Finally, the preference of Mr. Townsend to reduce the price of gas all round as much as possible, rather than give discounts for large consumption or prompt payment, is again striking at an approved ideal, which is practised as much as possible, but is infringed where necessity compels. It is an advantage in these times to talk of the day-load as much as possible, and to take active steps in its cultivation; but at the same time the interests of the lighting consumers must not be in any way neglected, for in this business electricity puts forward its strongest claims, with more or less veracity and effect.

Examinations in Gas Engineering and Supply.

Although the two papers read at the meeting on this subject did not treat of the immediate technical and commercial affairs of the gas industry, they have such an important bearing on those affairs—more especially in relation to the future—that they also court and deserve separate mention. The indirect advantages of examinations of the kind under consideration are as great as the direct ones. They encourage study, activate intellect, and broaden survey and interest; and, from this point of view alone, the examinations in gas engineering (including gas chemistry) and supply (including utilization) must have a most important bearing, through the candidates, among whom are the gas industry's

executive officers and responsible workers of the future, upon the prospective affairs of the industry. Talent requires opportunity and encouragement for its full development. The examinations give both. The intellect of the industry's aspirants to official positions has an incitant in the preparation work for the examinations; and the work conduces to fresh thought and enlarged ideas, the ultimate end and value of which cannot be seen. Though we agree with the author of one of the papers—Mr. J. H. Brearley, who until recently was the Examiner in Gas Supply—that examinations are not always a true test of technical worth, the good that there is in them in providing a motive for the industry's students, in evoking industry, and in raising the plane of competence, is of such a character that it is right the gas profession generally should know more of them, and, through the knowledge, be able to assist in eradicating the weaknesses of the examinations, and in improving them in order to invest them with still higher value from the industrial standpoint.

As Examiners, Mr. Thomas Glover in Gas Engineering and Mr. Brearley (now resigned) in Gas Supply, in their papers presented for the consideration of the members, show that they have used their positions to good purpose beyond the immediate requirements of the honorary offices, which requirements involve the setting of a number of questions in the attempt to make a fair estimate of the range of knowledge of the candidates, and in adjudicating upon the work done with equity, in order to allot to the candidates distinction in the matter of reward, if they deserve it. In the papers, we find that both have been observant of the strength and the weakness of examinations of the kind, as also of the candidates who present themselves for examination; and the dissemination of observation of this sort among those who should know of it, is precisely what is necessary to amend the conditions in the future. Candidates themselves should take to heart the strictures that are made, for they above all persons are the ones who are chiefly capable of rendering void a repetition of these charges on the part of the examiners. At the same time, we count it to the credit of the candidates that there is such a good number who year after year submit themselves to examination in the belief that their abilities will carry them through. But we would ask them to observe the significant statements of both Mr. Brearley and Mr. Glover. The former finds an enormous disparity in the qualifications of the candidates, as well as evidence of indifferent preparation or of poor tuition; while Mr. Glover finds that there is a considerable range in the quality of the answers given by the candidates. Why should these things be? We cannot find any excuse sufficiently strong to serve as a mitigant of these adverse criticisms, unless the aspirants for certified honour include a large proportion of men whose training is not of the order contemplated by the examinations. We have already admitted that examinations are not always a true test of technical ability. Many a man of strong technical ability cannot readily put his thoughts upon paper—the ordeal of examination, the knowledge that the work has to be done within a time-limit, and physical and mental characteristics, may each or all be against the success of a candidate in these examinations. The daily work of such men is the best ground on which to base judgment as to their abilities; and such men must not be passed by in the struggle for preferment. Yet making all allowance for personal disadvantage as distinct from personal ability, we cannot—with a first and second class for each examination—pass by the charges of indifferent preparation, poor tuition, and the remarkable differences there are in the quality of the answers, without the feeling that the candidates are mainly blameworthy for this condition of things, and that upon them must rest the responsibility of making improvement in this direction.

At the same time, there is the admission that there is an improvement in the quality of the work done in the ordinary grade; while the honours grade shows lamentable weakness. Inspecting the figures given in Mr. Brearley's paper for the ordinary grade in "Gas Supply," we see that the number of candidates in 1911 was double what it was when these particular examinations were instituted in 1908. But we are sorry to see the large proportion of failures—the large proportion of candidates who could not even secure a second-class certificate. In the honours grade in Gas Supply, there has also been a doubling of the number of candidates who present themselves for examination; but the numbers are of a small order, compared with the figures in the ordinary grade. This seems to indicate that, while a large number of candidates are anxious to secure a certificate of some kind, there are comparatively few of them who care to face the honours grade. This is a pity; it is something to be deplored, having in view the relative values of the certificates in the two grades. A very good reason is to be found among the strictures; and it suggests that a very small proportion of the candidates are willing to undertake the harder work required for the grade of higher honour. This reason is projected upon notice in both papers. We have in more than one place regretful confession on the part of the experienced Examiners that the answers reveal a large disregard of science and theory; for, as Mr. Brearley says, the best practice is undoubtedly that founded on the best available theory. In this relation, Mr. Glover calls attention to a much neglected part of one of the rules applying to these examinations: "Instruction in science should precede instruction in technology; and candidates are expected to pass the examinations in science and art, qualifying for a full technological certificate before presenting themselves for the final examination in technology." That this is not done shows an important weakness in the examinations; and it indicates where the candidates can themselves work to amend matters.

Another point is made by Mr. Glover of the feebleness of drawing and gas-engineering knowledge in the engineering examination. It has always appealed to us as a flaw in the value of the gas-engineering examination that oftentimes a candidate has been able to secure a certificate of proficiency in gas-engineering by passing the requisite number of questions all of chemical origin, or nearly all of such origin with a few minor engineering or works' management ones to make weight. This is absurd; but it could be remedied by setting gas chemistry apart from gas engineering and management, or by making a rule that a specified number of engineering and management questions should be answered and a specified number of chemical questions. But the division of chemistry from engineering, and a special certificate for candidates who distinguish themselves in both classes would be a great gain to the intrinsic value of the gas engineering examinations. Mr. Brearley makes a suggestion as to the extension of the lines of the Gas Supply examinations; and it does seem that revision is necessary when one considers the scope of work that there is in gas distribution and utilization for fully competent men—men with technical and commercial qualifications—while the work associated with utilization requires men as fitters over an extensive area of application who, with a certified knowledge of both theory and practice associated with utilization, would be invaluable servants to the gas industry. Mr. Brearley's proposal is that, if classes for the practical training of gas-fitters were instituted, and the present Gas Supply syllabus were altered to three grades, the end of a satisfactorily trained distribution staff would be ultimately reached. The benefits, he adds, of some such subdivision would be enhanced by having a preliminary science course adapted to the special needs of the gas industry. Alternatively, the ordinary grade might be divided into two sections—one embracing the gas-fitters' course, and the other treating of the remaining subjects included in the present syllabus. If this course were adopted, it would, he thinks, entail also the subdivision of the honours grade into two sections. Mr. Glover is also of opinion that it is worth while considering whether the Gas Engineering examination could not be made useful at the initial end for such men as foremen; and the final examination at the other end be made so comprehensive as to cause the certificate to be of greater intrinsic value. Men whose positions are not of the higher order cannot be barred when they voluntarily come forward for examination, fired by the ambition to secure some certificated evidence of their knowledge. Nothing must be done to repress legitimate ambition. Looking at the matter all round, it is certain that there is room for improvement in the examinations; and equally certain is it that the candidates can themselves do much to make the examinations of greater value to themselves and to the gas industry, whose interests they are seeking to show their competence to serve.

Manchester Gas Affairs.

The report of the Manchester Corporation Gas Committee for the financial year to March 31 last, the principal portions o which are reproduced in another column of this issue, possesses a number of interesting features; but unhappily on the present occasion a note of regret has also to be included. Unfortunately,

during the period under review, the Committee lost both their Chairman (Alderman Robert Gibson, J.P.) and their Deputy-Chairman (Alderman Thomas Briggs, J.P.), who had occupied their respective positions for a number of years, and had, as is well known, filled them with great ability. They left the undertaking in a state of extreme prosperity, as the report and accounts before us abundantly indicate; and the city of Manchester, as such, is undoubtedly greatly indebted to the administrators of this vast concern, and also, may it be added, to the consumers of gas. With an income of over £800,000 (which is substantially more than that of the preceding twelve months), there is a gross profit for the year of £195,000, compared with £190,000 for 1910-11. Interest on loans, &c.. demands the relatively small sum of £44,000; so that there is a net profit of £151,000. From this, nearly £75,000 has been allocated to the sinking fund for the redemption of loan debt, £50,000 has gone to the city fund in aid of the rates, and of the remainder some £16,000 has been applied in extension of works where borrowing powers are not granted. The second of these items is the controversial one—and the one that the consumers, at any rate, are most likely to keep their eye upon. In this connection, it may be remarked that concessions to certain classes of consumers are recorded in the report under notice. The price charged for gas used within the city for manufacturing purposes has been reduced from 2s. 3d. to 2s. per 1000 cubic feet, provided that the annual consumption is not less than 500,000 cubic feet; and the quantity of gas supplied through automatic meters for 1d. has been increased from 30 to 33 cubic feet within the city, and from 25 to 28 cubic feet beyond. Also the charge for gas consumed by public lamps within the city has been reduced from 2s. 3d. per 1000 cubic feet to a price that will cover the entire costs of manufacture, distribution, and management, and all other charges appertaining thereto, including capital and renewals charges. In connection with work in hand, it will be noticed that a retort-house at Rochdale Road works is being dismantled in preparation for an installation of vertical retorts. With horizontal retorts the carbonizing capacity of the house was 2 million cubic feet per day; and this will be increased to 4 millions with the verticals. High-pressure lighting is proving as successful in Manchester as elsewhere.

Some Statistics.

Along with the Committee's report and accounts, we have received a little book of statistics relating to the Manchester Corporation Gas-Works, compiled by the Superintendent (Mr. F. A. Price). These are so well prepared—the figures being bold, and printed on one side of the paper only—that they invite inspection. It is stated that the figures are for the year ended March 31; but in some respects (for purposes of comparison) Mr. Price goes back a great number of years. An item of interest on the first page is that gas was first introduced in Manchester in 1807, and works were established in 1817. The transfer of the undertaking to the Corporation by the Commissioners of Police took place in 1843. Coming to the year ended March last it is seen that the net profit per 1000 cubic feet of gas sold was 6·69d.; and of this 2·21d. was paid to the city fund, and 3·31d. was placed to sinking fund. The net cost of the gas in the holders was 9d. per 1000 cubic feet sold, and the net cost delivered 1s. 6·49d. As the price at which it was sold averaged 2s. 3·13d., there was a gross profit of 8·64d. per 1000 cubic feet, of which interest on loans absorbed 1·95d. A striking table is that relating to residual products. This shows that twenty years ago, in 1892, the income from coke, tar, ammoniacal liquor, and sulphate of ammonia was equal to 41·23 per cent. on the cost of coal and cannel, whereas for 1912 it was 71·91 per cent. In the period from the year 1892 down to the present time, no less a sum than £1,058,049 out of profits has been applied in relief of the city rates. The total amount applied in lieu, or in aid, of city rates since 1844 reaches the enormous sum of £3,065,084. The producing power of the different stations per twenty-four hours is given as 31 million cubic feet, and the storage capacity as 34¾ million feet; the largest consumption in one day having been just over 28¾ million feet. The total quantity of gas produced last year was 5693 million cubic feet, equal to 11,457 feet per ton of coal carbonized. The production of carburetted water gas was in the proportion of 18·16 per cent. to the total output; and the net cost of this gas (of 16-candle power) in the holder was 8·34d. per 1000 cubic feet. Hire is not charged for either meters or cookers; and gas-fires are supplied and fixed either on simple hire or on hire-purchase. The quantity of gas transmitted from the works last year (5687 million cubic feet) was 0·41 per cent. more than in the preceding twelve months; and of this total, 3·22 per cent. was unaccounted-for. The Committee's report shows that the increased make of 33¼ million cubic feet was obtained with a reduction of material carbonized equal to 4729 tons. The gas sold per ton of coal carbonized equalled 10,914 cubic feet; and it is interesting to note that the percentage of consumption was 94·53 within the city, and 5·47 without. In 1825, the price of gas in the city was 14s. per 1000 cubic feet.

PERSONAL.

Mr. S. R. Davies, of London, has been engaged as Assistant to Mr. S. Glasscock, the Gas Engineer and Manager of the Shoeburyness Urban District Council.

Mr. J. C. Moon, formerly Manager of the Vancouver and Victoria (British Columbia) Gas Companies, has relinquished the position in order to associate himself with Messrs. C. W. Stancliffe and Co., Limited, engineers, at Vancouver.

Mr. James Brodie, who early this year resigned the position of Gas Engineer and Manager of the Lisburn Urban District Council, on obtaining the appointment of City Gas Engineer at Edmonton (Canada), has taken up his new duties.

Mr. Thomas E. Harley, senior collector in the Manchester Corporation Gas Department, was last Friday presented by his colleagues with an illuminated address in recognition of his completion of fifty years' service with the Corporation.

Mr. Percy Melville Heath, Chief Assistant Solicitor to the Sheffield Corporation, has been recommended by the Town Hall Committee of the Manchester City Council as Deputy Town Clerk, at a salary of £1000 per annum. The chief work of the new official will be that of promoting Bills.

The visitors from abroad at the meeting of the Institution last week included the Hon. George Swinburne, of Australia, Mr. John M'Cubbin, of Hong Kong, Mr. Arthur Hewitt, of Toronto, and M. Jules Cordeweener, of Porto. They were very heartily welcomed by their friends, and by the members generally when their identity became known.

When noticing, towards the close of last year, some new testing and other apparatus devised by Messrs. Simmance and Abady, it was mentioned that in its production they had had the collaboration of Mr. Leonard A. Levy, head of their Chemistry Department. Mr. Levy's special qualifications for the position were alluded to at the time. He is a Fellow of the Institute of Chemistry, an M.A. of Cambridge, and was then a B.Sc., of London. We are pleased to learn that the latter title has since been changed by the University to D.Sc.; and we offer our hearty congratulations to Dr. Levy upon the fact.

Mr. F. J. Pearce, who was engaged under Mr. C. Stafford Ellery at the Bath Gas-Works, as Works Assistant, has obtained the position of Chief Assistant to the Engineer and Manager of the North Middlesex Gas Company, advertised in the "Journal" for April 16. Mr. Pearce began his career in the gas profession at Bath, receiving the whole of his training under Mr. Ellery, and filled various positions during over twelve years of service with the Bath Gas Company. On the occasion of his leaving, on Friday last, he was presented with a handsome leather suit-case and pipe by the staff and a silver-mounted umbrella by the workmen of the Company.

Those friends of Mr. G. R. Casterton, of Melton Mowbray, who were not present at the meeting of the Institution last week will regret to learn that his visit to London for the meeting was marred by an accident; but fortunately one from which he will speedily recover. Alighting from a motor bus in motion, he fell; and sustained nasty cuts and bruises. But after being treated at the hotel by a doctor, he was able—though bandaged—to pass through the greater part of the programme, including the visit to Cambridge. His own doctor has him now in hand, and gives him hope that, in a few days, he will have quite recovered from his uncomfortable experience.

Obituary.

We regret to learn of the death, on the 1st inst., of Mr. John Chambers, who was for many years Secretary and Manager of the Henley-on-Thames Gas Company.

The death has taken place at Torquay, at the age of 85, of Mr. William B. Beynon, head of the firm of Messrs. Beynon and Sons, gas and electrical engineers. Mr. Beynon was Vice-Chairman of the Torquay Gas Company, and was one of the oldest shareholders. He was actively associated with the Company from its earliest days, and had been a Director for forty years and Vice-Chairman for upwards of thirty years. One of his sons, Mr. Robert Beynon, is the Engineer and Manager of the Company. At the funeral last Tuesday, Mr. R. Kitson, the Chairman, with other Directors of the Company, and Mr. S. H. Easterbrook, the Secretary, and Mr. Duckworth, the Accountant, were present.

THE INSTITUTION OF GAS ENGINEERS.

PROCEEDINGS AT THE TENTH ANNUAL GENERAL MEETING,

HELD AT THE

ROYAL UNITED SERVICE INSTITUTION, WHITEHALL, LONDON,

JUNE 11, 12, and 13, 1912.

MR. R. G. SHADBOLT, OF GRANTHAM, IN THE CHAIR.

REVIEW OF PROCEEDINGS.

(For Full Report see page 823).

THE scene of the annual convention of the members of the Institution of Gas Engineers was changed on this occasion; and for this occasion only let it be devoutly hoped. The fraternal and magnanimous spirit of the Institution of Mechanical Engineers has not been extinguished. Time demands certain alterations and redecoration of their home; and hence this year the change of the meeting-place to the Royal United Service Institution, Whitehall. This is not by many times the first that the present assembly-place has heard the voice of the gas engineer on subjects professional and industrial. The defunct Institution of Gas Engineers was wont to meet there; the members of the old Gas Institute also gathered there in days long since. Times have changed, men have departed, new men have come, fresh subjects occupy the minds of the gas industry's chief workers. The process of consolidation has produced a united body, giving "united service" to the industry; and therefore it was not amiss to meet once again under such circumstance in the hall which saw assemblies of gas men in the schismatic days. The "once again" experience, however, will last for some considerable time, if it can be avoided in future.

The first morning's sitting was fixed for 10.30. But *réunions* and arrangements take time; and by the hour of meeting, there was not a very large attendance. Then the members streamed in; and soon the hall was filled to overflowing. Every available seat was occupied; every inch of standing room, save in the passage-ways, was occupied. Fortunate it was that the hall is supplied with large windows admitting of free ventilation, or the place would have become unbearably oppressive, for the morning sun shone at its brightest, and it was giving London, and gas engineers boastful of the heating value of their prime product, some striking account of its own thermal value. The appearance of the President (Mr. R. G. Shadbolt) at the door leading to the daïs was the signal for enthusiastic applause. Duty performed, in yeoman fashion, during an exceptionally arduous year, appeals to Britishers; and everyone at the meeting recognized that before them was one who had not suffered anything to stand between him and his duty to the gas industry and the gas profession in the honourable office to which he had been called by his fellows. "Well done" was expressed in those cheers. There were the Vice-Presidents (Mr. J. Ferguson Bell and Mr. Edward Allen) following close behind the President; also the Honorary Secretary (Mr. S. Y. Shoubridge) and the Secretary (Mr. Walter T. Dunn). There was the Council, too; they must all have been there—the members appointed direct by the Institution and the District Association representatives. Among them sat last year's President (Mr. Alex. Wilson). A little later the long line was joined by Mr. Corbet Woodall, who has an important part to fill in the coming Jubilee Year of the organization. A face was missing, and it was that of a staunch worker in the industry's organization—Mr. James W. Helps, whose indisposition has, for the time being, curtailed his old activities.

Criticism of the Report.

Promptly the President took us to the first business; and the presentation of the Council's report was among it. There was one critic—Mr. George Helps, of Nuneaton. He was desirous that the report should be referred back for various reasons. He was concerned in the first place over the fact that nothing had been done regarding the broadening of the constitution of the Institution. How much longer, he asked, is the Institution—a body of professional men—going to pretend to represent the huge gas industry. There was no answer forthcoming. It was clear Mr. Helps would have a composite body as the central organization, in which the whole of the industry's interests would be compacted. There were many sympathizers in the hall. Then his second point was one on which he declared with fervour that "if I do not speak on it, no one else will dare." Therefore, he was listened to with good-humoured tolerance while he questioned—not, let it be said emphatically, on any personal grounds, but on account of certain aspects of the paper—the propriety of the award by the Council of the Silver Medal to Mr. E. W. Smith for his paper last year on "The Uses of High-Pressure Gas for Industrial Heating Purposes." He acknowledged the good work Mr. Smith has done; but, for this paper, Mr. Helps failed to see that the adjudication of the Council was correct. Last year, too, the Council's critic suggested that they should consider the question of bestowing reward for work done; but no mention of the matter was made in the report, which indicates shelving. On these grounds, Mr. Helps moved that the report should be referred back; but there was no seconder. Yet Mr. Helps was abundantly satisfied, as he is confident many were with him; but the "many" were not prepared to take a part that would appear to be running counter to the Council in these matters.

Coal Strike Clause.

Up rose that old supporter of Institution debate, Mr. C. E. Jones, sympathetically inclined with Mr. Helps over the question of the broadening of the basis of the Institution, but evidently not at one sufficiently with him on the other matters to second his proposition. Mr. Jones rather objected to a point in the addition made to the Council's report on the subject of the coal strike clause. He disagrees with the provision [see *ante*, p. 716] as to coal deliveries being at the rate of 40 per cent. of the total quantity during the months from March to August, and 60 per cent. during the remaining months. He would prefer coal being delivered in equal monthly quantities; and therefore he suggested the deletion of the clause. The point raised by Mr. Jones is preceded by the words "unless otherwise mutually agreed." The President pointed out that the Council had been asked to suggest a clause; and the one recommended, having been arrived at by agreement between the coal buyers and sellers of Lancashire, and having been largely adopted in Yorkshire, is one that, it is considered, will appeal elsewhere. At the same time, the clause is only suggestive, and has merely been adopted by the Council as a suitable general clause. Later on, Mr. R. W. Edwards expressed the view that the clause will not prove satisfactory down south, where coal is largely purchased through factors. The clause states: "The gas authority shall within one month after the cessation of such disability determine whether they require the quantity short delivered owing to such disability to be cancelled or to be delivered." Mr. Edwards does not think the coal factors associated with the London market will agree with this provision. On the other hand, the President opines that what the colliery proprietors will agree to, there is no doubt the coal factors will accept, because they will pass on their responsibility to the collieries.

The recommendation as to the general acceptance of this clause remains.

Street-Lighting Specifications.

The report was rich with material for discussion; and the President—calling attention to the question of the report on the position of the drafting of a street-lighting specification by a Joint Committee composed of representatives of the Institution of Electrical Engineers, the Institution of Municipal and County Engineers, the Illuminating Engineering Society, and the Institution of Gas Engineers—invited Mr. Jacques Abady (whom he properly described "one of the greatest authorities extant on street lighting") to address the meeting on the subject. It is very clear that Mr. Abady is not in sympathy with the position to which this matter has drifted after all the serious conclaves of the Joint Committee. The present report is an interim one; and for that small mercy Mr. Abady is manifestly truly thankful. Briefly, the basis so far reached for the specification is the prescription of a minimum illumination on the horizontal plane at a height 3 ft. 3 in. above ground-level. Now Mr. Abady contends that the specification of a minimum illumination in a street by no means conveys the proper measure, or any adequate idea, of the illumination in that street, nor does it convey any proper measure as between one form of illumination and another. The whole criticism was one the Joint Committee will do well to consider; and it will be found fully set out in our "General Report of the Proceedings." The specification of a minimum illumination was strongly criticized; and we heard about the effects upon the amount of the illumination in a street of the initial candle power of the sources of light, of the height of the source in relation to the law of inverse squares, and of the distance of the sources of light one from the other. All which considerations point, Mr. Abady holds, to the absurdity of the form of expression proposed by the specification being any rational guide to the amount of illumination in a street. He asserts that the only way to make proper measurement is to assume what is a fact, that the light from any source will come in zones concentric with the source, and to measure the illumination at certain distances from the source, and at certain angles to the source. He condemns the minimum illumination test also from the point of view of strong contrasts as between maximum and minimum. To sum up, if the proposed specification is persisted in, he suggests that either the Institution should withdraw from the Committee, or that their representatives should issue a minority report Mr. S. B. Langlands was not entirely in agreement with Mr. Abady's "negative position;" but the main point of his remarks shows that photographs he has been taking in Glasgow streets of the lighting there have convinced him of the more perfect diffusion of the light from gas mantles than from electric arcs. He also withdrew the doubt he expressed a year ago as to high-pressure gas-lamps not being capable of developing 60 candles per cubic foot of gas consumed. Since then he has made many tests, in company with Mr. Walter Grafton; and he finds himself duty-bound to withdraw last year's criticism. The meeting evinced signs of being very much in sympathy with Mr. Abady's strictures; and the President pointed out that the report is only an interim one on what has taken place in connection with the Joint Committee. The Council feel that they are being "rushed;" and they are not at present recommending that anything in the report should be adopted. The prospect of unanimity upon a street-lighting specification looks more remote than ever. And it is not surprising. However, the discussion will be a guide to the Council in their future action.

Alkali Manufacturers' Monopolizing Campaign.

Intent were the members when this question was introduced as arising out of the report; and the applause that punctuated remarks on the subject, and the demeanour of the members generally, disclosed the resentment that there is throughout the industry over the action of the chemical manufacturers and the proceedings in the Parliamentary Committee rooms. The subject was introduced by Mr. Thomas Glover, who called upon the meeting to endorse the action that the President and Council had taken in this matter, and to give them an assurance of their support. He further suggested that the Parliamentary Authorities should have before them the view of the meeting that the chemical manufacturers should not have a monopoly, and that the gas industry should retain the right of free trade in their residuals. What is being done, in Mr. Glover's opinion, and he was cheered in saying it, is very hard upon those small concerns that are being deprived of the help their neighbours can render them in this matter. The nail was hit on the head by Mr. E. H. Hudson when he characterized this as one of the most important matters before the meeting, and said with emphasis that this restriction will be carried to an extreme end without effective representation from the gas industry. The way in which the restricting clause has been inserted in Bills this session shows the subtle manner in which the whole thing has been, and is being, worked. Mr. Hudson also mentioned the difficulty at the present time of getting competitive prices for ammoniacal liquor and tar, and of different undertakings obtaining sulphuric acid except from one particular chemical works. The chemical manufacturers constitute one of the strongest combinations in the world; and Parliament has been assisting in making it stronger still. The speaker urged the Parliamentary Authorities to consider that the penalty of their action is not only on gas undertakings, but on the gas consumer. He hopes, and we all hope, that the action of the Council and the representations that are being made will be rewarded with success. Contribution to the discussion was made by Mr. R. W. Edwards; and then Mr. D. T. Livesey well illustrated the commercial strength of the chemical manufacturers by giving details of instances of oppression on small gas undertakings. The upshot of the discussion was that, on the motion of the President, with a hearty seconder in Mr. Samuel Glover, a resolution was passed conveying the view to those chiefly concerned that the action of the chemical manufacturers, in endeavouring to prevent unrestricted trade in gas residual products, is not in the interests of the gas consumers, and pledging the meeting to oppose any curtailment of the powers of the gas industry. The unanimous passing of the resolution gives the Council a mandate upon which they may freely act. It was mentioned by the President that 700 replies had been received to the inquiries sent out; but there are many more to come in, seeing that 1600 copies were circulated. He asks for these to be forwarded, and especially for further evidence of cases of oppression.

Medal Awards.

Then came the presentation of medals; and Mr. Dru Drury received an almost overwhelming ovation as he was called by the President to the dais to receive the London Medal, provided by Mr. H. E. Jones for engineering merit in papers submitted for discussion. But honour fell with double force upon Mr. Drury; for the Council also made him the recipient of the Institution gold medal—this being the first time a gold medal has been awarded by the Institution. When Mr. E. W. Smith was called to receive the silver medal, any doubt that may have been in his mind as to whether the views of Mr. George Helps were endorsed by the members generally was removed; for he had a very enthusiastic reception. Interpreting the view of the meeting, the President turned Mr. Helps's criticism to advantage, by remarking that he thought, possibly, it had, if anything, added to the lustre of the medal. It was a happy phrase in which he asked Mr. Smith to look upon the medal not only as a recognition of valuable work done for the industry up to the present time, but as an indication of the anticipation of the industry of valuable work being performed by Mr. Smith on its behalf in the future. There was a notable remark in Mr. Smith's reply. It is that in future high-pressure gas, especially for metallurgical work, will hold its own better than any other form of gaseous heating that is being talked about at the present time. Mr. J. G. Newbigging was unfortunately not present on Tuesday; so that the presentation of the bronze medal for his paper on "The Scientific Carbonization of Coal" could not then be made.

Presidential Address.

Then came the Presidential Address, which was published *in extenso* in our last issue. It was a brilliant essay, rich in thought, broad in view, and comprehensive of contemporary matters. The earnest convictions that have been established by the President's deep personal perceptivity were expressed with the quiet, unobtrusive confidence that is a characteristic when the President has anything upon which to make public pronouncement. The only part which the President gave in abstract was that referring to Sunday labour; the whole of the rest, from beginning to end, he

read. There was not a dull moment. The progressive thought in well-turned periods, and the variety of the matter, kept interest from flagging. As the address went on, interest indeed expanded, until the final words had barely escaped the lips of the President when applause went up such as has never been exceeded, if equalled, in expressiveness on such occasions. Eloquent as was Mr. John Carter in proposing a vote of thanks to the President, the eloquence of the applause was even more expressive; and Mr. Carter himself thought it was a superfluous thing to follow on this occasion the conventional form of thanks. The seconder was Mr. John Bond; and the confirmation was a repetition of the previous enthusiastic ovation. Comment upon the address appears in our editorial columns.

Refractory Materials.

The last matter to be considered at Tuesday morning's sitting was the report of the Refractory Materials Committee. There was a thin "house" by this time. The report was submitted by the Hon. Secretary to the Committee (Mr. F. J. Bywater). It constitutes the third section of the standard specification, and refers to silica bricks, tiles, &c., containing upwards of 80 per cent. of silica—the term "siliceous" being applied to material containing 80 to 92 per cent., and "silica" to material containing upwards of 92 per cent. There is little use summarizing a report of this kind; the value of its detail being its important part, and that will be found in the reprint in the present issue. It was greatly regretted that the Chairman of the Committee (Mr. James W. Helps) could not be present to present the report; but Mr. Bywater, where refractory material is concerned, is an excellent substitute. The Committee do not claim finality for their work; but they regard what has been done as an excellent sub-structure for good retort work in future, if the specifications are adhered to, and if purchasers will only see that this is done. They claim the right of amendment as progress and experience may dictate. These are points from Mr. Bywater's remarks; and he made due acknowledgment, too, of the co-operation of the manufacturers through their section of the Society of British Gas Industries. There was warning, however, that the specifications would involve the manufacturers in additional cost; and therefore purchasers must expect to pay a little more, but the extra cost will be a good investment. The seconder of the adoption of the report was Dr. Harold G. Colman. While Mr. J. P. Leather is of opinion the Committee are working in the right direction, he does not think they have gone far enough. What in his opinion is wanted is to make the standards high enough, in order to cut out those manufacturers who are not working as they ought to do. As to temperatures, his view is that the Committee have not reached a sufficiently high test for refractoriness. He suggests the purification of the raw fire-clay; and the adoption by manufacturers of higher standards of temperature than those to which the material will be subjected in use, so as to meet the difficulty of excess local temperatures. He thinks expansion and contraction are also important points to be taken into consideration. Mr. G. H. P. Perry, the Chairman of the Fire-Clay Goods Section of the Society of British Gas Industry, spoke of the willingness of manufacturers to work to the specification. Dr. R. Lessing bore witness to several of the points raised by Mr. Leather having been considered in Committee. He made his view clear that it is no use legislating for abnormal conditions. The available raw materials are the ones with which gas men must work; and specifications of this sort must be for the bulk, and not for special circumstances. The figures in the report are the minimum limitations; and any buyer can ask the manufacturers to go higher if he likes. Anxious to obtain 15,000 and 16,000 cubic feet of gas from a ton of coal, Mr. W. B. Randall is desirous of having material that will stand higher tests than those prescribed by the Committee. He is anything but satisfied with the material that is supplied under the specifications to-day. He cannot understand, too, why the tests should be carried out in an oxidizing atmosphere; while in actual working conditions a reducing atmosphere obtains. Mr. Thos. Canning thinks the Committee's first specification requires amendment in the matter of the baking of retorts. To all of which criticism Mr. Bywater pointed to the impossibility of trespassing on the domain of the manufacturer; and he thinks it sufficient for the purchaser to specify his requirements. The temperatures quoted in the specifications are all higher than those found by tests in actual working in many places. On the point of contraction and expansion, the Committee considered they had provided full protection there. Retorts ought not to be homogeneous and of dense texture, but of sufficient porosity to allow of variations of temperature being taken up without cracking. Upon this statement the report was adopted.

Joint Commercial Sections.—Cooker and Tar Prices.

In the afternoon the Commercial Sections of the District Associations met in joint conference; and it attests the important place that commercial matters of all kinds hold in the minds of the members that they turned up in good force. The President was in the chair; and Mr. Samuel Meunier, the worthy Convener, was with him to render assistance. Mr. E. H. Hudson, who has been acting as *locum tenens* to Mr. H. Kendrick, whose indisposition rendered necessary a temporary relinquishment of the work, has been a highly efficient substitute; and we had evidence of it on more than one occasion during the week. He is explicit to the highest degree in his explanations; and no one can fail to follow and appreciate the statements he makes. There was a hint at the outset from the President as to certain lines of development that are possible in future—in future be it marked; the time is not ripe yet. When it is seen how the British Commercial Gas Association matures, it may be that it will become the central organization of the Commercial Sections. The scheme for the education of gas-fitters was presented by Mr. Hudson; and it was approved, so that it went forward to the Institution next morning with the endorsement of this conference upon it. The recent rise in gas-cooker prices was a matter that was also discussed; and the "JOURNAL" article [May 14] on the subject was brought into prominence, being described as a dispassionate statement of the case from inquiries made among the makers. We are glad the intended tone of the article was appreciated. However, there still seems to be a feeling of dissatisfaction over various points; and it was resolved to form a small Committee composed of one representative of each Commercial Section with the view of meeting the gas-stove makers. On the question that has arisen for gas undertakings in connection with the unemployment section of the National Insurance Act [*ante*, p. 697], there was a little discussion. But no action was taken, as the matter is, as already stated, under the consideration of a Joint Committee of the Gas Companies' Protection Association and of the Institution; and it was hoped, as a result of the meeting of the Committee later in the afternoon, to make some announcement before the end of the sittings of the members of the Institution. The Committee are charged with the duty of submitting a case to the Umpire. The perennial subject of tar prices was considered. This is one of the most knotty points in connection with the commercial affairs of the industry with which we have to deal. For example, some buyers and some sellers are pleased with the figures published in the "JOURNAL;" others are not. But as we were saying recently, let them drop out of our pages for a week or two, and letters reach us from all parts of the kingdom, expressing the hope that non-publication is not to be permanent. It seems the Commercial Sections, with all their machinery, cannot obtain a really satisfactory record of district tar prices—something always comes in to vitiate reliability. However, the subject was referred back to the several District Associations for them to deal with as best they can.

Benevolent Fund.

The first business on Wednesday morning was that of the Benevolent Fund. This is always one of the most regretful part of the proceedings, as comparatively few members appear to take sufficient active interest in this channel of charitable work to attend to hear the observations on the annual report. The Committee have increased their liabilities for the coming year; and so there was another appeal for an addition to the number of subscribers. It was mentioned by Mr. J. Ferguson Bell that the subscriptions last year amounted to £185; and this, divided among the 900 members of the Institution, averages less than 4s. each. The President hit the mark when he said that, making appeals at such a meeting as this is much like preaching to the converted. What is wanted is that those outside should come in; and, by doubling the number of subscribers and the amount of the subscriptions, they would then be able to boast of an average of 8s. per Institution member.

Education of Gas-Fitters—The Next Move.

This subject has been before the District Associations, in consultation with other interested bodies, for a considerable time now. But at length there has been a final agreement between all the bodies concerned; and the District Associations, through the Commercial Sections, now hand the matter over to the Institution for it to build practically and effectually upon the foundation that has been laid. The report on the subject includes a history of the movement; and there is embraced the finally agreed syllabus for the education of gas-fitters, who are to have an instructor's certificate after passing faithfully and creditably through the course laid down. Mr. Hudson succinctly stated the lines events have taken. They have been somewhat difficult ones; but all's well that ends well. The report was adopted after discussion; and the next move is for the Council of the Institution to approach the City and Guilds of London Institute to add the subject of gas-fitting on the lines of the syllabus to their present technical classes. Mr. W. Cranfield was heard on behalf of the Junior Associations in connection with this subject; the point he principally made being that he thought, and the Junior Associations thought, that it would have been to the benefit of the discussion of the business if the juniors had had an opportunity to put forward their views, as many of them came very closely into touch with gas-fitters. They want as organizations to be of active service to the gas industry. A letter from the Joint Committee of the Junior Associations was read by the President, in which the desire was expressed that their organizations might be allowed representation on the local Committees that it is recommended shall be formed to carry through the scheme. This, the President indicated, is a matter that can only follow a successful result of the approach by the Institution of the City and Guilds of London Institute. Then the application of the Junior Associations will receive every consideration; and, if at all possible, the utmost use will be made of their services.

The Day-Load Factor.

Then commenced the consideration of the technical and other papers; and by this time there was a considerable attendance of members. A better lead off could not have been given than was done by the contribution of Mr. H. Townsend, of Wakefield. It is some four-and-twenty years since he was before the Institution with a paper. Into this contribution he has put a vast amount of difficult compilation, and has, with perspicacity, drawn deductions from the mass of collected statistics. The paper to one acquainted with the labour involved in the preparation of material of this kind represented more than the actual extent of the print. The incidence of the day-load is a subject that declines to be treated in any hard-and-fast or off-hand manner; and Mr. Townsend himself indicated before he had proceeded far that local conditions which refuse to be adequately described—the characteristics of population and industry, hours of working in the latter, and so forth—all come in to upset the most careful attempts to draw conclusions. His tables and charts also show the impossibility of saying, in general terms, that what is not good practice for one place is not good practice for another, or the reverse. Local conditions may altogether annul the application of any such rule. We are glad to find that the Wakefield Company stand in a good way of getting quit of the absurd restriction which compels them to supply gas at a level rate for all purposes.

Local and Other Conditions.

Mr. Townsend's investigations were chiefly among the industrial cities and towns of Lancashire and Yorkshire; and to that extent may not apply to many other districts of altogether dissimilar characteristics. He finds a decided family resemblance in the day-load among kindred industries—that is, for want of a better division, taking the day-load as referring to the hours between 6 a.m. and 6 p.m. His figures show the importance in relation to the whole business of, from the point of view of volume, the day-load. Here we have a group of towns manufacturing woollens and alpacas with an average day-load of 47·50 per cent.; a group of towns with coal mining as the principal industry, with an average day-load of only 30·89 per cent.; a group of towns manufacturing cottons, with engineering as one of the staple trades, with an average day-load of 43·70 per cent.; and another group of towns, with coal mining as the principal industry, with an average day-load of only 33·60 per cent. Watering places and market towns come out on top, with an average day-load of 48·20 per cent.; and market towns and railway centres with an average of 41·39 per cent. The character of the staple trade in these industrial parts of the country appears, from the figures and charts, to have the greatest influence in determining the amount of the day-load. Then if summer is distinguished from winter, in the former the percentage of the day-load is increased by reason of the diminution of the night-load, as well as by the large cooking load. Another characteristic is that the towns with a large summer day-load have also a large average day-load for the twelve months; and those with a small day-load for the twelve months have also a small summer day-load. Among the further lessons, is that the gas equivalent in price to a ton of house coal has an influence on the amount of gas consumed per head of the population. The comparative local values of gas and coal, too, exert more influence on the day-load than the price of gas for cooking. It is rather surprising, too, to find that the selling of gas at very cheap rates does not (according to Mr. Townsend) necessarily imply a heavy day-load. The undertakings selling the cheapest gas in the world boast of day-loads equivalent in one case to 41·22 per cent., and in the other to 36·94 per cent. It is also noticed that the general tendency is for the average consumption per meter to increase as the gas equivalent in price to a ton of coal increases. The type of slot consumers have an impression on the day-load. In Yorkshire, the rule is for a falling off in the day-load as the percentage of slots increases; but this is not confirmed by the Lancashire statistics.

Methods of Promoting Day-Load.

The difficulty of deduction is shown by these facts. There are some general factors brought into consideration. Advertising, show-rooms, and free maintenance of apparatus pay. The concerns that neglect these things suffer in having the lowest consumptions per head of the population. Mr. Townsend favours the patronage of all inventions that induce consumption; and he welcomes the new taxi-meter for hotels, pensions, and so forth. Differential charges are good in some places; but they have small effect in others. In his own case, Mr. Townsend says that low flat-rates are preferable to differential charges. At the same time, competition compels the reduction of the price for power and industrial uses below lighting rates. In the eyes of the author, for substantial reasons, discounts for prompt payment have no favour. At Wakefield, the bad debts only amount to 0·7d. per 1000 cubic feet, without the system of discounts. He has a strong preference for cheapening the price of gas for all purposes, though in some cases attractive discounts for industrial purposes are justified. Mr. Townsend does not say whether or not he is in favour of a discount for cooking purposes; but he finds many points in its favour, though there is the additional meter or the discount meter to be provided. He can hardly place domestic heating in the same category as power, industrial use, or cooking, as the heating is required in the winter and overlaps the lighting load. The popularity of washing-boilers in the North is referred to. An important factor, too, is water heating; but that is a service required almost as much during the hours of lighting as in the day time. At the back of Mr. Townsend's mind, there seems to be a little resentment over the growing desire of consumers to be supplied with apparatus free; and he argues, and with propriety, that in such cases consumers so supplied ought not be furnished with gas below lighting rates.

To sum up, the extent of the day-load depends largely on locality and trade; it is desirable to foster the day-load by all sound methods; it is wise to give substantial discounts for power and industrial purposes; where appliances are fixed free or at unremunerative rates, then gas should not be supplied below lighting rates; flat-rates are preferable to differential rates; and it is preferable to reduce the price of gas all-round than to give discounts either for large consumption or for prompt payment of accounts. So spoke Mr. Townsend. But he disclaimed the laying down of any hard-and-fast rules that can be said to be applicable to all undertakings.

Unacceptable Basis for Day-Load.

The discussion must be taken as being the best of all on any of the papers, from the practical point of view, for the gas industry. There was no one among the speakers who

contested the commercial and financial benefits arising from the day-load. The speakers were Mr. J. P. Leather, Mr. W. B. M'Lusky, Mr. J. F. Bell, Mr. Edward Allen, Mr. Thomas Glover, Mr. H. E. Bloor, and Mr. W. Whatmough. The most destructive of the criticism was aimed at the arbitrarily adopted base of 6 a.m. and 6 p.m. as representing the day-load. It is clear that these hours have no justification for recognition as a proper base for the day-load for comparative purposes—in view of local conditions. But no one suggested a better base—no one can do so, except for his own individual circumstances. The first to show its unsoundness was Mr. Leather, whose maximum day delivery is in the winter time; for the reason that Burnley has a considerable lighting load, which stops absolutely at 5.30 in the evening, and comes on again at 6 o'clock in the morning. There is also Mr. Allen, who measures his night load as between dusk and daylight, or rather sunset and sunrise. The result is that he has a 58 per cent. day load in June, July, and August. By this process of eliminating from the day-load all hours in which gas is used for lighting, he finds that in April he is down to a 44·3 per cent. day-load, and in September to 44·1 per cent.; the minimum being in December, with 24·7 per cent. But there must be a great overlapping of other uses than lighting with the lighting load. Mr. Thomas Glover also points out that a high percentage day-load may be produced by comparison with a low lighting load. If he eliminates the lighting load entirely at Norwich, he finds that he has a higher output per hour in the winter daylight hours than he has in the summer daylight hours. His experience is that people who have cookers fixed for summer use continue to employ them in winter; and this helps the daylight hours' consumption during the latter period. Mr. Bloor believes in comparisons being made on "per head of population" basis; and his investigations convince him that the lowest price towns have the largest consumption per head of the population. With this, Mr. Townsend says he entirely agrees. Clearly day-load comparisons present some curious anomalies and difficulties.

Prices and Increasing the Day-Load.

Much was said by speakers on the question of the price of gas for encouraging its daylight use. A studious investigation (the full report will show) has been made by Mr. Bell into the costs affecting this matter; and he has come to the conclusion that, if the day-load factor is increased by 50 per cent., it is possible to reduce the price by some 25 per cent. That prices must be brought down to encourage people to use gas for purposes other than lighting, is the sincere conviction of Mr. Thomas Glover. For these purposes, electricians are selling gas at one-fifth the price for lighting. The gas industry will feel this if it does not do something to counteract it. His view is that the gas industry could sell gas for day purposes at half the price of gas for lighting with advantage, or, at any rate, it can do much for industrial purposes by reduction of the charges. On the other hand, it appears to Mr. Bloor that the day-load can only affect one item of expenditure—that is, storage. What about mains, services, management expenses, collection, and so forth? At the same time, Mr. Bloor is at one with other progressive spirits in encouraging the use of gas for all purposes; but he warns the gas industry of the mistake of overlooking the lighting-load in the anxiety to increase the day-load. A personal experience of Mr. Whatmough is that differential prices are very desirable. Without their aid, he would have had to encounter, through electrical competition, an absolute decrease in consumption; whereas he has a good increase to his credit. Price is an important point in developing day-load. But what are the other lines of development? These vary with the local circumstances. Mr. Thomas Glover has not, for example, any considerable scope left to him in the matter of cookers. For in an estimated 25,000 houses, he has 20,000 cookers fixed. He is now looking for development to water heating, and workshop and laundry appliances. There are gas-fires, too; but these went without mention in the discussion. Mr. Leather's experience with hire-purchase does not coincide with Mr. Townsend's. At Burnley he has twenty times the number of cookers on hire-purchase that he has on hire—the actual figures being 3000 sold direct, 6000 on hire-purchase, 300 on hire. What is the number of householders in Burnley? Mr. M'Lusky fails to understand those managers who refuse to give facilities to gas consumers that will increase consumption, seeing that such facilities cost so little per 1000 cubic feet sold, while contributing a good revenue.

High-Pressure Gas in Manufacture.

There are few, if any, gas engineers who can claim a larger or longer experience than Mr. A. W. Onslow (the reader of the next paper) of the employment of high-pressure gas in the heating or melting of metals on the small and large scale—his experience having been gained at that centre of heavy and light work of all descriptions, the Woolwich Arsenal. Such opportunities as he had there are given to but few men; and he made the best possible use of them, to the advantage of the gas industry, as much as to the national economy. Progress in arts and manufacture is built on experience. The paper that he read gave an outline of his experience, and some of its practical, useful, and enlightening lessons. It is an easy matter, he tells us, to design gas-furnaces; but results depend upon the perfection of the details. He deals unsparingly with the defects of the old designs—all in the interests of progress; and he lays it down as an axiom that, to secure proper design and resulting economy, a gas-heating engineer is necessary to collaborate with the mechanical engineer—the latter knowing what is required, the former bringing his knowledge to effect it in the most economical and certain manner. This results in economy of both time and fuel, and in reliability of result. He mentions an instance where economy of gas has been effected in a manufacturing undertaking to the extent of 50 per cent. through placing the heating arrangements on proper bases. This is important to the manufacturer and to the gas industry, and the cheapened production to the country at large. To obtain such results were, in short, the commendable intentions with which Mr. Onslow (he does not say so, but we know it) set to work to revolutionize the furnaces at the Woolwich Arsenal, using high-pressure gas in the work of reformation.

An important problem to be dealt with was the proper mixing of gas and air. Under the old order of things, it was quite a laborious matter to secure this with a number of burners in use; and the result was always indifferent. Thus Mr. Onslow came to the conclusion that gas must be maintained at a constant high pressure; air be drawn in under atmospheric conditions; and, with the regulation of these sources, definite results could be obtained. If the work was then conducted under known tabulated conditions and requirements, certain results could be both promised and maintained. This point being settled, he started to reduce the old large combustion chambers, in which the flame had to travel over extensive areas before getting to effective work. By a reduction in size of the chamber, and compelling the flame to at once strike the fire-clay, with a restriction of the air supply, uniform temperature was obtainable. Quick heating and the equal maintenance of the temperature of the table of the furnace were the results. By the methods he devised, he is able to get a definite progression of temperature in relation to definite intervals of time, as is shown in his paper. The importance of the ability to regulate temperatures in this manner is obvious. In one old form of furnace working under the former crude methods, he has found as much difference in temperature as 600° Fahr. He refers to furnaces built for special work; and then brings out the point as to the superiority of gaseous fuel over coal. Melting-pots for printers' type may be cited as an example. In this work, taking labour and wastage into consideration, gas costs less than coal. He does not mention the relative prices of the fuel; but it is an experience under comparative conditions. This particular type-metal pot, one-third full, was melted by three burners in thirty minutes; two-thirds full, in 45 minutes; and full, in 70 minutes, or 60 minutes with smaller flue. For a 15-cwt. pot, the consumption per burner is 80 cubic feet. A 1-ton pot is provided with four 100 cubic feet burners; one of the burners only being required after the first melt. To melt these pots of metal by coal occupied two-and-a-half hours; while now the foundry can be ready for active work in half-an-hour, or less if desired.

Several hints are to be collected from the paper bearing upon wear and tear and efficiency. Experience shows that, with gas at 2s. per 1000 cubic feet and coal at 20s., there is little difference in the matter of the cost of fuel; but the difference is in favour of gas with furnaces designed to produce the greatest economy. But upon fuel cost alone, judgment must not be based. Economy of time, certainty with high-

pressure gas, cleanliness, and much else have to be placed to the credit of gas. Nothing need be left to chance. Mr. Onslow finds it difficult to understand why manufacturers and large engineering works requiring heat have not generally and more quickly adopted high-pressure gas for their purposes—more especially seeing that the plant can be used for both heating and lighting; and the pressures mostly required for heating (65 to 80 inches) are equally suitable for lighting. He suggests that a desideratum is a cheap and efficient means of compressing gas up to 15 lbs. The author also discusses the question of a suitable burner; and finishes his paper on the charm of the simplicity and control of high-pressure gas.

High-Pressure Preference.

The point that was most prominent in the discussion of Mr. Onslow's paper was the preference exhibited in all quarters for high-pressure gas for industrial heating, on account of its manageability, certainty, and other merits. Those who took part in the discussion were Mr. W. H. Y. Webber, Mr. J. P. Leather, Mr. R. W. Edwards, Mr. E. W. Smith, Mr. Newton Booth, and Mr. W. Wilson. The discussion was not extensive but it was very gratifying to the author. Throughout it, his successful work was acknowledged, and by Mr. E. W. Smith in no unstinted terms. He described Mr. Onslow as a pioneer in the work of applying high-pressure gas to metallurgical purposes, and spoke of his personal assistance to him in his early steps in investigation work in this connection. Mr. Leather also alluded to the common sense that Mr. Onslow had brought to bear upon this work; and Mr. Webber rated highly the practical success with which the author had grappled with the problems. Mr. Leather made a point of the fact (and Mr. Smith confirmed it), that, for the highest temperature efficiencies, there must be proper admixture of the gas and air--not merely a proper proportioning of the air, but an intimate admixture of the two. Then speaker after speaker bore witness to the fact that for the higher temperatures this can only be done with certainty—the "with certainty" must be emphasized—by having the gas under high pressure and the air at atmospheric pressure. Mr. Newton Booth who is Mr. Onslow's successor at Woolwich Arsenal) was particularly emphatic on this point. His experience is that it is more difficult to keep the mixtures correct with high-pressure air and ordinary pressure gas, than with the high-pressure gas and air at atmospheric pressure. Like Mr. Onslow, he does not like leaving anything to chance. At the same time, the discussion produced plenty of testimony to the effect that high-pressure gas is not required under all conditions—for instance, Mr. Smith knows many good muffle furnaces that will give perfect results up to 1000° C. with gas at ordinary pressures. There was much else in the discussion, but bearing more on details; and the full report will disclose them to those interested in this brief outline of the salient features.

There was little time left of this sitting; and members began to show some uneasiness and a disposition to depart, as the sitting had already extended to three hours.

Evolution of the Stockport Gas-Works.

Under the circumstances, Mr. Samuel Meunier filled up the time by explaining in outline the contents of his paper, in which he tells the story of the evolution of the Portwood Gas-Works of the Stockport Corporation, at which works are now concentrated the gas-manufacturing operations of that thriving industrial centre. The work he describes, and which has been carried out from his plans, has been developing, part by part, as required since the year 1895. The long period covered, the extent of the work, and the many thousands of pounds spent upon it, represent the material for a big narrative; but Mr. Meunier showed his capacity as an engineer in another field than that dealing with building construction and commodity production, by compressing the narrative of all these doings in a pamphlet, excluding drawings, not exceeding sixteen pages. How to review the paper in any manner that can serve any really useful purpose is a problem that defies solution; and therefore we will just point out here the lines that the constructional work took. From the brief indication, it will be seen that anyone engaged on any similar work will find some valuable guiding information in it.

The first work taken in hand in 1895 was the construction of a complete range of workshops, the dimensions of which, and the main lines of equipment, are mentioned. In the same year, it was decided to put down sulphate of ammonia plant; but after the buildings were completed, the Committee determined to sublet the sulphate section to a manufacturer, who put down the necessary plant and worked it on a schedule basis. From this, the Committee have seen no cause to depart. About the same time the condensers were doubled in capacity. The following year, a ½ million carburetted water-gas plant of the Humphreys and Glasgow type was installed, with all accessories equal to duplication of the generating part. The relief holder is on the Gadd and Mason principle. The oil-tanks are fed by gravitation, through a 4-inch steel main, from the railway-sidings about ¼ mile away. Since then there has been a duplication of the water-gas generating plant; or rather, the new set was of ¾ million capacity. Further when the generator shells of the first set required renewing, they were also replaced by a ¾ million set; so that the plant is now equal to well over 1½ millions. A new meter-house succeeded. Details follow as to extension, by Messrs. Ashmore, Benson, Pease, and Co., of No. 2 gasholder by the addition of two lifts on the rope-guided principle—the entire work being carried out without emptying the tank. How the work was executed is described in the paper. It is interesting to learn—as experience has not been large with rope-guided holders—that the extension has worked satisfactorily; and the cost of maintenance has been very small. The stability of the holder, too, has been proved on many occasions. It appears that an important point is to have the ropes regularly and periodically examined and greased—every two or three months being the practice at Stockport.

Arriving at 1899 in this historical record, new purifying plant was installed; four boxes being constructed with space in reserve for an additional catch box. These are each 57 ft. by 27 ft. by 3 ft. 6 in. deep, and are built on Green's system. The connections are so arranged that any number of boxes can be worked simultaneously, either singly or in rotation, and any one can be made the leading box, but the travel of the gas must be in one direction. A number of interesting details connected with this plant are given; one feature being an economical method of mechanically handling the material by the aid of an electric motor. Early in the last decade extensions were made to the condensing plant; and subsequently the necessary apparatus for cyanide extraction was put in—this being followed by a Livesey washer for dealing with naphthalene. A little later came the most important extension and reconstruction—that of the carbonizing plant. Inclined retorts were adopted; but the dimensions of the house and an extraordinarily large main flue, concrete encased, running down the centre of the house presented some engineering features that required careful negotiation. There are four benches of four arches, each fitted with twelve 15-feet inclined retorts. The furnace is arranged in the centre of the bed. The question of radiated heat was dealt with by embedding in the front and back walls of the arches of the settings 2½ inches of slag wool, and also fastening a thin iron plate on the inside of the mouthpiece and filling the intervening space with slag wool. As an additional precaution, a 4½-inch wall, with openings left for access to the dampers, sight-holes, &c., was built up lineable with the edges of the mouthpieces from the floor to above the level of the top mouthpiece. In this way, a 30-feet run of retort was obtained where previously there had only been a 20-feet run; the daily productive capacity of manufacturing plant being 2¼ millions, against the ¾ million previously.

Succeeding this was the complete equipment of breaking, screening, elevating, and conveying plant described in the "JOURNAL" in April, 1907; and then an account is given of the construction of a reinforced concrete liquor storage tank—the Kahn system being the one adopted. Not the slightest sign of fracture or giving in any part has been discovered. A boiler-house and boilers, an air-compressor, a mention of further additions in hand, and a reference to the installation of a steel high-pressure main to a district 5 miles away, with compressors of the Ingersoll-Rand type, supply other sections of this interesting communication. Mr. Meunier finds that the high-pressure system is not more costly than an enlarged low-pressure main would have been; and it offers much greater elasticity for future extensions. The extensions described represent an expenditure of upwards of £92,000; and, including those carried out prior to 1894, over £130,000. Mr. Meunier has had a busy and varied constructional time at Stockport.

Suggestion and Inquiry.

The discussion had to be postponed until the following morning's sitting. Though out of place here in the sequence of events, it may be stated that when, after the paper by Dr. Lessing, discussion was invited on Mr. Meunier's paper, the only member to make response was Mr. Samuel Glover. The fact is a paper dealing with actually executed engineering work does not lend itself to much discussion, as one can do little more than praise or criticize a man's work under such circumstances, and criticism to an extent must carry reflection in the eyes of those incompetent to judge of the value of the criticism upon the work of the responsible engineer. But there was no adverse criticism from Mr. Samuel Glover. He saw the difficulties of the site, of its environment, of the disadvantages under which the works suffer from having no direct railway communication, and of having inadequate storage. He suggested that perhaps Mr. Meunier could lower the level of the yard, and construct a large coal-bin the same as he had done on the banks of the river for tar and liquor. He sympathized with Mr. Meunier for not having been able to realize his ambition to get a railway siding into the works, and hoped that this would in due time be managed. There was the question of the rest-stones, too, in connection with the gasholder extension. Two holder tanks being in proximity, Mr. Glover was curious to know how the rest-stones were being extended without removing the water from the tank. There was a little twinkle in Mr. Glover's eye, as he suggested that, when Mr. Meunier was considering the reconstruction of the works, he should take into calculation the additional manufacturing capacity he is able to obtain by adopting vertical retorts. But Mr. Meunier is not sure on this point. He prefers to wait—before he comes to a final conclusion on the matter—for the time when Mr. Glover has to reconstruct his settings. Mr. Glover seems to think that Mr. Meunier will have to wait a long time. On the point as to increased coal storage, Mr. Meunier's inclinations are in the direction of overhead coal-bunkers for ease in handling the coal, and for saving labour. The question of railway access to the works is an old one; but ratepayers have voices, and the voice of protest against the railway crossing a main street into the works has been heard and respected. The alternative is an overhead inclined road and steam lorries. Carting does not cost Mr. Meunier more than 3d. per ton; and one cart will do 45 tons a day—the distance to be traversed being only ¼ mile; so that the matter is not such a fearfully pressing one. As to the extension of the rest-stones of the holder, the services of a diver were requisitioned.

Income-Tax and Depreciation Allowance.

The question of depreciation allowance in respect of income-tax seems happily now fairly under way to settlement. As a matter of fact, a provisional agreement, subject to the approval of the Board of Inland Revenue, has been effected between representatives of some important gas companies, of the Institution, and of the Inland Revenue Authorities. The question is one which affects the whole gas industry; and therefore with the professional representatives of the gas industry in London last week, it was a good idea to call them together on Wednesday afternoon, to lay before them the agreement that is only now awaiting the Board's endorsement. The President occupied the chair; but the principal explanations of the matter were made by Mr. Corbet Woodall and Mr. William Cash, the Chairman of the Joint Committee who have had the matter in hand. The first point is that the scheme shows a desire on the part of all concerned to arrive at some equitable solution of the difficulty which has aroused so much resentment, and has caused so much bitter trouble. Gas companies are asked to send in an intimation of their approval of the scheme within the next month [it is fully explained elsewhere in this issue] ; and they are strongly recommended to do so. It may be that there will be some companies who will consider that in certain respects the proposals fall short of what is proper and fair; but it is suggested to the administrators of such undertakings that they should consider the scheme as a whole, and not merely in part. So considering it, it is generally regarded as being an excellent scheme from the point of view of equity, and one that should stop any further trouble when endorsed by the Inland Revenue Board. Of course, there may be some managements of gas undertakings who consider that extraordinary circumstances apply to them; they will be quite at liberty not to accept the scheme, but may appeal for amended terms. They will, however, have to prove the special circumstances that entitle them to departure from the lines of what is now before us. Of course, such a scheme cannot cover everything. As will be seen from the lucid explanation made by Mr. Cash, there are various subjects not included. Briefly put, the scheme is that in connection with plant, machinery, and mains, an allowance is to be made on renewals instead of wear and tear—that is to say, when renewals are charged to revenue an allowance for depreciation will be made; but the charges against revenue can be made over a number of years. In addition to repairs, 3 per cent. is to be allowed on gasholders, not including tanks, save when constructed of steel or iron. In addition to repairs, there may be granted 10 per cent. on the written-down value of meters (ordinary and prepayment), cookers, and gas-fires. No depreciation is to be allowed on services and fittings; but, in lieu thereof, all expenditure is to be allowed as a trade expense as and when incurred. There are some minor conditions; but this, in brief, is the scheme adopted.

Comparing the Coking Properties of Coal.

We come to the last morning's sitting, which it was arranged should commence half-an-hour earlier than usual, in view of the large amount of business still crowding the *agenda*. But not all the members knew of the change in time; and there were therefore comparatively few present when Dr. Lessing, in darkened room (owing to the use of lantern slides), introduced to the members a laboratory method for making comparisons of the coking properties of coal. But before he had proceeded far, the room became crowded; and he was followed throughout with the greatest interest. There was no necessity, however, for Dr. Lessing to defend laboratory experiments before a body of present-day gas engineers. In the gas industry, except in a few quarters where maybe ignorance still exists, the engineer and manager has left far behind the days when it was the wont of some men to turn their backs on the miniature scale work of the laboratory. The laboratory experiment is informative—positively so in some cases, and approximately so in others. There are some processes, however, the full value of which as producers from raw material cannot be assessed except on the large scale; and coal carbonization is one of them. To attempt to use a small laboratory experiment in respect of coal carbonization for any other purpose than comparing, under definite conditions, the behaviour of coals, their relative values under those conditions, and to examine the characteristics of the products yielded by different coals—all useful for study and for guidance—would simply be unreasonable. Dr. Lessing recognizes this in his paper. But with him all will agree that there is value in experimental work under the exact conditions that are only procurable by working with small quantities.

They are extremely small quantities of coal upon which Dr. Lessing works—only gramme quantities in powdered condition. The apparatus he employs for this purpose consists of an outer heating-tube, a retort tube of silica, and a weight in the form of a piston tube (to prevent the powdered coal being dissipated) also made of silica; the weight of the latter being altered at will by placing quartz powder in it. The arrangement is heated electrically. With it Dr. Lessing, as the paper shows, has been able to make an extensive study of different phenomena associated with carbonization—of the differences in the expansion of coals at various periods of their charges and after complete coking, and of the physical and structural characteristics of the coke. The considerable differences that exist are illustrated in the paper. The appearance of the coke produced should prove valuable in distinguishing various kinds of coal. The difference in the characteristics may be ascribed to chance by some; but Dr. Lessing will not have it so. He claims as his proof the wide range of his investigations. Admittedly altered experimental conditions will produce different results; but the same conditions realizable with his apparatus will always yield identical results from one particular coal. The apparatus also gives scope for investigating how a particular coal will behave when under varying conditions.

While mainly the apparatus is intended for the study of carbonization phenomena by the coke produced, Dr. Lessing has extended its use to the study of the volatile products.

In doing this, he closed the retort tube, and connected it to a gas-collecting system. In the paper, he describes the little necessary auxiliaries for this purpose. By their aid, he is able to extend the examination of various coals for their comparative gasification properties at various temperatures, although he does not submit that conditions of carbonization on the working scale are found in this experimental work. We see this in comparisons (using the same coal) with Dr. Davidson's working-scale experimental results as published recently in the "JOURNAL" pages. Dr. Lessing obtained, using the charging temperature employed in Dr. Davidson's tests, a much lower yield of gas; and for probably two reasons—one that in all likelihood the temperature in the Birmingham retorts rose substantially higher than the figure named during the duration of the charge, and that, in Dr. Lessing's experimental work, the tar did not undergo the same amount of secondary decomposition as in the gas-retorts. However, by increasing his experimental temperature, the yield of gas was brought close to the average obtained by Dr. Davidson. But this difference in condition—constant experimental temperature as compared with an increasing retort temperature in working—is fatal to any real comparison in the matter of volatile products. Except in the case of unsaturated hydrocarbons, there was fair agreement between the composition of the gas obtained in Dr. Davidson's working trials and in Dr. Lessing's experiments. The latter impresses very strongly the exercise of caution in the interpretation of results. It is necessary. The experimental process is not intended for reproducing works' operations; but there is use for it for comparing the values of different coals to meet various requirements.

Coking One Thing; Gasification Another.

There was congratulation and acknowledgment to Dr. Lessing from the President, who pointed out that work of this kind requires experience of a high order. A vote of thanks was proposed by Dr. Colman, who commented on the value of small-scale experiments in such complex matters as carbonization; but, at the same time, Dr. Colman endorses Dr. Lessing in his warning that a great deal of common-sense must be applied to the interpretation of the results of small-scale experiments. He regards the new method of obtaining information as to the coking properties of coal a great advance on the old crucible method. There was a little scepticism on Dr. Colman's part as to the gasification results, though he agreed as to the extraordinary congruity there is between the results of Dr. Lessing and Dr. Davidson—the latter working upon a 20-ton plant. The vote of thanks was seconded in his usual happy style by Mr. A. F. Browne; and it had a hearty endorsement.

Examinations.

The major part of the remainder of the sitting was taken up with the consideration of the subject of examinations—examinations as applied to gas engineering and gas supply. The papers were by the experienced examiners Mr. Thomas Glover for "Gas Engineering" and Mr. J. H. Brearley for "Gas Supply." Mr. Glover was very modest in regard to the length of his paper; but there was weight in his observations. On the other hand, Mr. Brearley made a critical examination of the subject from the gas-supply point of view; and the ground he has opened in this particular direction of the gas industry's work and business—work and business both technical and commercial—is of such importance that much of what he has to say will be of value as a guide in future. The work that he took in hand when originally accepting this examinership (now resigned, with a capable successor elected in Mr. Walter Hole), involving as it did the responsibility of initiating the work, and marking and cutting out the high road along which it should go, was obviously of an onerous character; and in it Mr. Brearley has not failed.

Science Should Precede Technology.

The paper by Mr. Thomas Glover was, as already remarked, very brief. As examiner in "Gas Engineering," his views are important. He is of opinion that the annual examinations are an incentive to both organized and individual study. Many owe their positions to the discipline and study which were necessary for passing these and kindred examinations. Mr. Glover is struck by the great range of the quality of the answers given by candidates. We are afraid that more honoured in the breach than the observance is the City and Guilds Institute rule which states that instruction in science should precede technology, and that candidates are expected to pass the examinations in science and art qualifying for a full technological certificate before presenting themselves for examination. It is a point worth considering whether, in order to increase the importance of the test and add to the value of the certificate in the Ordinary and Honours Grades, candidates should first pass an elementary science and arts examination in chemistry and mechanical engineering; and candidates for the final examination in Gas Engineering should qualify by first passing, in the advanced stage, similar science and art examinations. Comment is made on the weakness of the drawing and sketching abilities of the candidates. To have to conclude that the majority of the students are better taught and qualified in chemistry than engineering is not entirely satisfactory to the examiner when candidates succeed in passing who have manifestly had but modest training on the engineering side.

Where Weakness in Knowledge Exists.

From the information presented in Mr. Brearley's paper, the number of candidates presenting themselves in the gas-supply examinations prove both their popularity and their necessity; and the character of the work done by the candidates, taken as a whole, confirms the necessity not only as a test of knowledge possessed, but as a stimulus to a deeper and broader study of affairs relating to distribution and utilization theories and practices. When we see that in 1908 the number of candidates in the ordinary grade was only 152, while in 1911 the number was 339, there is attested the popularity; and the candidates, too, for the honours grade, though the numbers are not large, have more than doubled—41 as compared with 89. But it is to be regretted that there is such a large proportion of candidates who fail to get through even in the second-class of the ordinary grade. Take 1911 as an example. Then 105 first-class ordinaries were secured, and 132 second-class, while there were 102 failures. Passing to the Honours Grade, of the 89 candidates who presented themselves, 21 passed in the first-class, and 37 in second-class, so that there were 31 unfortunates. The difficulties of both examiners and candidates are acknowledged by Mr. Brearley. Equity and the difference between his own mature knowledge and that of the candidates demand of the examiner especial care. There is the class of candidate who never can, and never will, show true technical worth by any examination of this kind; while on the other hand, a man of mediocre technical calibre but keen intellect in other respects may go sweeping home with the full, or nearly the full, number of possible marks to his credit. But Mr. Brearley points out that the examinations have shown the directions in which there is need for developing knowledge; and they are also stimulating. Through them the gas industry will be supplied with a strong body of highly trained men in this department.

As remarked, the examinations show the directions where knowledge is strong and where it requires amplification. In the Ordinary Grade, the candidates appear to be generally well informed on gas-fires; the subject of mains and services also appeals to them. In meters, slot mechanisms are not well understood; and more instruction by dissection is advised. House governing and regulating pressures appear to be well appreciated; but knowledge as to the sizes of pipes in relation to requirements needs boosting up. In the theory and application of luminous and bunsen flames, there is not that diffusion of knowledge that is desirable. So we go on, until we come to the gas-engine, in connection with which it is found that more demonstration is required of construction, working, and repair.

In regard to the Honours Grade, we will not go through the paper, but merely say that it is evident that in Mr. Brearley's opinion, candidates are weakest when theoretical considerations enter into the subject of a question. Looking to the bad points rather than to the good, gas compression is not satisfactorily understood; improvement is also required in the theory and practice of illumination at different angles from various types of burners and globes. Again candidates are not strong on the plotting of illumination curves. Improved tuition is also required in water heating by gas. The thermal efficiency of the cooking-stove is a matter that does not appear to have struck many as one of importance. Gas power is a subject that is not satisfactorily studied. However, the best report in favour of the candidates was that for 1911—showing that, in Mr. Brearley's judgment, the candidates are now better prepared for what is likely to face them.

Suggestions.

Towards the end of the paper, Mr. Brearley expresses the view that, if classes for the practical training of gas-fitters were instituted, and the present gas supply syllabus altered to three grades, the end of a satisfactorily trained staff would be ultimately reached. The benefit of some such subdivision would be enhanced by having a preliminary science course adapted to the special needs of the gas industry. Or, alternatively, the ordinary grade might be divided into two sections—one embracing the gas-fitters' course, and the other treating of the remaining subjects included in the present syllabus. This would also entail the subdivision of the Honours Grade.

An addendum was also made by Mr. Glover to his paper. He does not see why they should not have an examination for foremen, as he finds that many of the answers are of a quality that one would expect from a studious foreman. This suggests to him that for the coming professional man the quality of the examinations should be raised; but he made the gratifying announcement that, in his last report as Examiner, he was able to speak to an improvement in the quality of the drawing in the Ordinary Grade. But there is not the same improvement in the Honours Grade.

A Long Discussion.

It was a long discussion to which the papers gave rise; and the attendance was large the whole of the time the subject was under consideration. This indicates the importance the gas profession places upon the question as to the future proper manning of the industry. The discussion opened with an announcement by the President that Mr. Arthur Hewitt, of Toronto, was with them that morning. He extended to him a cordial welcome, and asked him to give the members some account of how the subject under discussion appealed to him from the Canadian standpoint. Mr. Hewitt spoke of the comparative smallness of the gas industry of Canada; and this led him to the point that, in the training of their young men, each engineer has to employ his own particular method; but British lines were followed as much as possible. In passing, he mentioned that they have to deal with big increases in consumption nowadays in Canada—15 to 17 per cent. being the rate compared with corresponding months. The participators in the discussion were Mr. George Helps, Mr. A. F. Browne (an ex-Examiner in "Gas Engineering"), Mr. William Cranfield, Mr. James Paterson, Mr. Harold W. Woodall, Mr. Herbert Lees, Mr. Walter Grafton, Mr. W. H. Y. Webber, and Mr. Walter Hole (the present Examiner in "Gas Supply").

Revision Necessary.

There is no question, from the discussion that took place, that the general feeling is that some revision is required in the examinations, and that a new value should be attached to them. But there must always be kept in view, the ultimate object of all such work as this, which is (as was so well expressed by Mr. Hole) that those who come in the future to occupy high or responsible places in the gas industry shall be men who have been thoroughly trained, and who know what they are dealing with, both from the theoretical and the practical points of view. It struck Mr. Browne, as it did many others, that the Examiners both spoke of the quality of the answers given by candidates; and Mr. Browne made a very illuminating and analytical examination of the matter. He and others can only come to the conclusion that there is an absence of that preliminary knowledge of science and proper grounding that are necessary for these examinations. This suggests an investigation of the causes; and, taking the views of the Examiners and of the speakers—Mr. Cranfield and Mr. Lees, for example—into consideration, it can only be concluded that a good proportion of the candidates are young men of a type for whom the examinations as they exist were never intended. Yet the difficulty is that they cannot be shut out; they must not be shut out from gratifying a worthy ambition. As Mr. Cranfield says, the great proportion of the candidates who present themselves for examination do so voluntarily, and few under the pressure of their chiefs. There is in these examinations a stimulus that is of great value. The difficulty is to legislate for the condition. Mr. Harold Woodall does not think examinations should be carried so far as the foremen. To do this is, in his opinion, treading on dangerous ground. "Nothing in the world, in the case of such men, can replace self-reliance and initiative." The education scheme for gas-fitters, too, has resolved itself into instruction without examination; and Mr. James Paterson asks that the essential difference between education and examination should be realized. He feels that we are at the turning-point in this matter; and unless we realize that examination is not the end, but simply the means to an end, we shall go astray. "The more a man learns, the better for his employer; but too much in the way of qualification should not be put upon the career of the fitter." With all of this there may be agreement; but that does not dispose of the question of how the candidates of the types in question are to be dealt with. Of course, the proportion of such candidates who offer themselves for examination, and cannot properly tackle the questions set, makes the results look worse. Mr. Cranfield and Mr. Hole seem to indicate a way out of the difficulty, by suggesting an elementary examination paper, and then making the final examination in the Honours Grade one to cover the whole subjects, and so make the certificate one of considerable value. Mr. George Helps thinks that the examination questions should not be set by anyone who cannot answer them himself; and he suggests a Board of Examiners. To this the President replies that the Council of the Institution is the advisory body; and, in his opinion, the syllabus they have agreed upon is not too difficult. Mr. Grafton hopes that, if a Board is formed, a representative of Scotland, Ireland, and Wales would be included, so that due consideration should be given to local terminology in the framing of the questions. From all of this it looks as though the subject will now be kept to the front (there are many members interested in doing this) until some revision is made.

With this discussion, which was the longest during the meeting, and did not once drag, the programme of papers and debate ended; and then the members proceeded to address themselves to other business.

The Jubilee President.

The result of the ballot for office-bearers and new members had been posted up in the vestibule during the meeting; but the President made the formal and gratifying announcement that Mr. Corbet Woodall had been elected as the President for the Jubilee Year of the Institution—a position which he now occupies upon the solicitation of the members of the gas profession, by virtue of his position as their recognized leader. Another popular announcement was that Mr. John Bond has been elected Junior Vice-President—Mr. Edward Allen being now the senior; Mr. J. Ferguson-Bell having retired from the Senior Vice-Presidency to allow Mr. Corbet Woodall to take the presidential chair during the Jubilee Year. Mr. Woodall, in acknowledging the honour that the gas profession had conferred upon him, seemed a little dubious as to the wisdom of the members in this particular matter; but the profession know fully what they desire, and their gratification is found in the accomplishment of that desire, as was evidenced by the acclamation when Mr. Woodall rose to express his acknowledgments. There is work before Mr. Woodall during his year of office outside what was the old conventional or routine work of the Presidents in days now passed. He recognized this in saying that no effort would be spared on his part to maintain not only the reputation of the meetings, but of the work that had characterized the year of Mr. Shadbolt's presidency. The Institution, he remarked, is now associated with matters outside the paths of engineering and management; and this makes the organization one of importance not only to the gas profession, but to the gas industry at large. The gas profession and the gas industry will look forward with interest to the coming year.

Jubilee Gas Exhibition.

Already the arrangements for the Jubilee Gas Exhibition are shaping well. A guarantee fund of £10,000 is required to demonstrate to the country at large on a proper scale the position of the industry in the Jubilee year of the Institution; and £4000 has been promised in the first batch of responses to the appeal for guarantees. This was the satisfactory announcement made by the President. The halls that have been provisionally secured for the purpose at the White City at Shepherd's Bush have been visited by Mr. Woodall, Mr. Charles Carpenter, and others; and there appears to be unison in opinion as to their fitness for the purpose. Those who read the report of the statement made on the subject by the President [see the General

Report] will observe that subscription entitles undertakings to a considerable number of tickets for free distribution according to subscription. The success so far achieved, as Mr. Shadbolt aptly said, shows the new spirit that is moving the gas undertakings of the country. Let this exhibition be a testimonial to the progress and applications of gas such as the industry has never before experienced.

Concluding Business.

The President of the Société Technique du Gaz en France, the President of the German Association, and Dr. W. A. Bone, F.R.S., the first occupant of the Livesey Chair at the Leeds University, were unanimously elected Honorary Members. London was fixed as the next place of meeting for the Institution—there was no alternative for the Jubilee year. There were also votes of thanks to all who deserved them; but especially may be mentioned the one to the President for the generous work he has given to the Institution and to the gas industry, with considerable sacrifice and a conscientiousness that could not have been exceeded. The work of the Hon. Secretary (Mr. S. Y. Shoubridge) and of the Secretary (Mr. W. T. Dunn) was also gratefully acknowledged.

Reading and Discussion of Papers.

The old trouble, but not to the same extent as at previous meetings, has been experienced at this—that is, as to the inadequacy of the time set apart for the discussion of papers. The view is that too much time is spent on the reading of the papers; and a very general feeling is that those who wish to discuss communications will take the opportunity of their early preparation and issue of making themselves acquainted with the contents, and be ready to discuss them. If this is so, it would save a considerable amount of time that could be profitably utilized in discussion. Even an abstract of each paper could be prepared to indicate the, or to refresh the memories of those present at the meetings as to the, contents of the papers. Mr. H. E. Bloor feels very keenly on this matter; and just before the proceedings terminated at Thursday's sitting, he, in an able indictment of the present practice and procedure, gave expression to his feelings over the matter. After some discussion, it was agreed that, as the subject has been formally raised, the Council should consider it, and submit a report at the next meeting. It is fully time that something was done in this connection.

This ended the business at the regular sittings; and the other engagements for the week were of a social order.

SOCIAL EVENTS OF THE WEEK.

The week was a thoroughly enjoyable one. The weather, on the whole, was kindly; the only day on which the elements were in unfavourable mood was Thursday. But otherwise all other days were excellent in their meteorological conditions. Tuesday and Wednesday evenings were free for social arrangements; and so was the latter part of Friday evening.

Masonic.

The social events really started on Monday evening, when the "Evening Star" Lodge (No. 1719), in continuation of established custom, were hosts of members of the masonic fraternity in the Institution and (this time) in the Society of British Gas Industries. The "Emergency Meeting" was held in the Grand Lodge Temple, Freemasons' Hall, Great Queen Street. The W.M. of the Lodge (W.Bro. C. W. Offord, of Enfield) presided; and the other officers present and occupying their respective positions were: W.Bro. Cyril G. Davis, I.P.M.; Bro. W. Edgar, S.W.; W.Bro. E. G. Smithard, J.W.; W.Bro. Thomas Cash, Treasurer; W.Bro. Walter T. Dunn, Secretary; W.Bro. W. A. Surridge, D.C.; W.Bro. A. E. Croager, S.D.; Bro. J. Fred. Wicks, J.D.; Bro. Archibald P. Main, I.G.; W.Bro. Fred J. West, W.Bro. H. W. Packham, Bro. Samuel Carpenter, Stewards. The business transacted consisted of the initiation of Mr. F. J. Bywater, of the South Metropolitan Gas Company, and Mr. Richard B. G. Glover, of Messrs. Thomas Glover and Co. The W.M., on behalf of the Lodge, welcomed the President and members of the Institution of Gas Engineers and the other visiting members present; and, at the close of the business, a party numbering some 220 members of the Lodge and guests dined together—subsequently participating in the enjoyment of a musical entertainment.

Reception and Dance.

The reception and dance on Thursday evening was nothing short of a brilliant success. There was a change, and a beneficial one, on this occasion from the old Princes' Rooms in Piccadilly to the Connaught Rooms, in Great Queen Street. The spaciousness of the place, the convenience of the several large rooms, and the decorations, all combined to make things more attractive. The President and Mrs. Shadbolt were radiant with the pleasure that the response to their invitation had received. For an hour they were welcoming their guests—about 600 all told; and there were only a few late-comers whose engagements had prevented an early arrival. But at the end of the reception of the constant incoming stream over the hour from eight to nine o'clock, the President and his wife looked as fresh as though they had not received more than a tithe of the number of friends.

Just before the reception, there was a happy and thoughtful incident. The Manchester District Institution of Gas Engineers (through Mr. Samuel Glover, their President) presented Mrs. Shadbolt with a beautiful bouquet of flowers; and the Eastern Counties Association (through their President, Mr. F. Paternoster) also presented one to Miss Shadbolt. Each District President was accompanied by his wife, and a number of the members of the two Associations, of both of which Mr. Shadbolt is a member and a Past-President.

The spirit of consolidation of the interests of the gas industry, through the men and workers of the industry, was again manifest; the President having invited the members (as had been done to the extent of the masonic element by the "Evening Star" Lodge on Monday) of the Society of British Gas Industries—all principals of large manufacturing firms in the industry—as his guests. It was a *réunion* in more senses than one; and the occasion lost nothing of lustre and joyousness from the fact of this merging of old friendships on this social occasion. Looking around, there were the signs of the improvement by the infusion of fresh life into gatherings of the kind.

In the course of the evening, Mr. Corbet Woodall, the President-elect—now the President—and Miss Woodall paid a visit to the festive scene, and spent some time conversing with all and sundry who were not otherwise engaged in the pleasures of the evening. Mr. Milne Watson and others of the staff of the Gaslight and Coke Company were among the visitors. It was an excellent programme that had been provided.

During the reception, the Imperial Orchestra discoursed lively music in the Grand Hall, in which from nine o'clock until midnight, with an interval of half an hour, the merry dance proceeded—the M.C. being Mr. Samuel Shadbolt. In the drawing-room there was a vocal concert. Not a few sought their enjoyment in this direction; while others who found the greater attraction in the dance-room had here an enjoyable temporary respite from the more active form of pleasure. The Grand Hall, large and lofty, is a beautiful place for a dance; and in this respect the change of the scene of these events must be described as a vast success. The ample arrangements, too, for light refreshments were greatly appreciated. At all times, and in all places, wherever the President and Mrs. Shadbolt moved among their guests—the largest "party," we hazard the opinion, they have ever entertained in their lifetime—they found pleasure at its height; and pleasure showed its gratitude privately, and in, on appropriate occasions, an expressive manner—more particularly in the supper room, during the interval in the programme. Time was fleet of foot this evening; and the hands of the clock passed all too quickly to the hour where the one day ends and the next day begins. It was a big proportion of the guests who found that hour had arrived before they had thought of departure.

Excursion to Cambridge.

Friday morning broke doubtfully. Anxious eyes glanced skywards—with misgivings; the meteorological reports were carefully consulted with no better success in the gleaning of certain information as to what provision the Clerk of the Weather had made for contributing to the enjoyment of the trip to Cambridge, or for damping the spirits of those who were going to participate. But as events proved, he

was well-disposed. During the day there was a little sunshine, and not too much—just sufficient to make things, natural and otherwise, look bright and cheerful. Therefore the outing was less fatiguing than it would have been with a broiling hot sun. There were unappreciative people—some who did not know what Cambridge has in store for the visitor—who thought there was a dreary sort of day in front of the party. But there were about 260 who considered otherwise, and who formed a formidable crowd just before eleven o'clock at Liverpool Street Station when waiting for the "special" that was to place space for a few hours between them and London. A good time was spent conversationally and otherwise, by friends on the outward journey. Arriving at the great University town, they were met on the platform by Mr. J. W. Auchterlonie, the Engineer and Manager of the Cambridge University and Town Gas Company, who directed them to the motor vehicles that were waiting to convey the huge party to the Guildhall. The President, Mr. Auchterlonie, the indefatigable Hon. Secretary (Mr. S. Y. Shoubridge), and Mr. Dunn were not many minutes in seeing the whole party safely on board; and a start was made to enjoy the delights of a day in Cambridge under especially favourable auspices. The destination of the vehicles was the Guildhall; and the route there was so marked out that one saw in passing the Fitzwilliam Museum, the Peterhouse and Pembroke Colleges, the Pitt Press, Corpus Christi, St. Catharine's and King's Colleges. But these were only outward signs of the collegiate splendours of the famous town that the visitors were to afterwards enjoy. Arriving at the Guildhall, where the travellers were to have luncheon, the visitors had the pleasure of meeting the Chairman of the Gas Company (Mr. E. H. Parker, M.A., J.P., D.L.), the Vice-Chairman (Alderman W. B. Redfern, J.P., D.L.), and two other members of the Board, Mr. C. T. Heycock, M.A., F.R.S., and Mr. J. Peace, M.A. Mr. Horace Darwin, M.A., F.R.S., the other Director, who is also Chairman of the Cambridge Scientific Instrument Company, was unable to be present. There were further present Professor W. J. Pope, M.A., Alderman W. P. Spalding, J.P., and other representatives of the University and civic life of Cambridge. There was also Mr. R. Wardell, Mr. Auchterlonie's principal assistant, who heartily seconded his chief's efforts at putting all the last touches necessary to the making of the visit in every respect one to be remembered.

The luncheon was a thoroughly enjoyable and liberal one; and afterwards a short toast list received attention. The King was toasted; and, the band striking up the National Anthem, over 260 voices made the hall ring with the manifestation of their loyalty. Then

Mr. Alex Wilson, in a happy speech, proposed the University and Town of Cambridge. He spoke of the fame of the University, and of the renowned men who had spent part of their years in preparation for their life's work within its walls. He claimed that Glasgow had some connection with Cambridge; for the Principal of the University there (Sir Donald Macalister) came from Cambridge. There was a no more popular man in Glasgow to-day—not only for the learning and wisdom he displayed in carrying on the work of the University, but for other personal qualities. The chief work of Universities was to turn out men—men who knew how and when to act at the proper time. There was not much direct connection between Universities and the gas industry; and yet he thought there was a similarity of purpose. On the banner of the men at one of the stations of the Glasgow Gas Department, the words were emblazoned "We labour to lighten the path of life." The University authorities were also labouring to lighten the path of life; and in this way there was some connection between the humble gas stokers and the Professors and Masters in the Universities.

Professor Pope replied on behalf of the University; and he, in humorous mood, found a great connection between Cambridge and the gas industry. The staple industry of the town was the turning out of gas, in the shape of lawyers, ministers, politicians, and so forth. The teachers, like the members of the gas profession, earned a living wage. Of course, their products varied somewhat; but at any rate, as Mr. Wilson had said, the purposes of their respective products were somewhat analogous, although that turned out by the gas industry was much more illuminating than that which was frequently turned out by the University.

Alderman Spalding, who regretted the unavoidable absence of the Mayor, referred to the happy relations that existed between the town and the Gas Company. The Town Council was not one of those bodies who thought that nothing could be done unless by a municipality. The Council did not think the Gas Company could be managed better than it had been. During the last coal strike, the Company performed their duty well; and they relieved the minds of the people of Cambridge very much by the manner in which they met the difficulty. The Company had accumulated a large stock of fuel; and in the most generous manner, they supplied gas and coke without increasing the price.

Mr. Edward Allen remarked that the visitors had very special pleasure in drinking to the health of the Cambridge University and Town Gaslight Company. Their friend, and the representative of Cambridge in their Institution (Mr. Auchterlonie), was well known to them for his skill, scientific ability, and managerial powers. The interests of the Company were safe in his hands. He was glad to hear the last speaker, as representing the Town Council, pay a tribute of praise to Mr. Auchterlonie. The gas industry had connection with the town in another way than through the Gas Company—that was, through the Cambridge Scientific Instrument Company, who had supplied the gas industry with splendid instruments, which had helped them greatly in dealing with the problems of carbonization, and in solving them with much greater success than they could have otherwise done. He should like to mention the names of two gentlemen who were largely responsible for the excellent results in the work done there—Mr. Darwin and Mr. Whipple. The visitors were very grateful, too, to the Chairman and Directors of the Gas Company for the hospitality they were going to show them that afternoon, and for their and their officers presence and guidance during this visit to the town. They believed this visit would be long remembered as a very interesting one, and as being associated with one of the most successful meetings the Institution had ever held.

Mr. E. H. Parker thanked the visitors for the manner in which they had received the toast. It was a great pleasure indeed to hear Mr. Allen refer to the devotion of Mr. Auchterlonie to the Company's interests. The Company indeed were greatly indebted to Mr. Auchterlonie for what he had done since he had been at Cambridge. He had to a large extent reorganized the works; and he (the Chairman) hoped some of those present would find time to go and see them. The works had been greatly improved; the manufacture of gas had been greatly improved; the capital charges had been reduced from 9½d. to about 7⅛d. per 1000 cubic feet of gas; and they had adopted that most important system—co-partnership. After an experience of two years, he (the Chairman) recommended everybody who was responsible for the manufacture of gas to take a similar step. The country was going through anxious times in the labour world; and they had to ask themselves where justice came in, and what was the best course for the protection of the public. Justice could be done to men if they gradually made them co-partners. Mr. Alderman Spalding had already alluded to the good relations existing between the Gas Company in the town and the municipality. The Corporation were the Company's watchdogs; and therefore the Directors were glad to hear that they had met with their approval. They had heard of their University being gas producers. However that might be, this he did know, that the University had produced for the Company's Board three very valuable men. They had Mr. Darwin, who was also the head of the Cambridge Scientific Instrument Company. They had Mr. Heycock, who was a F.R.S., and a chemist, and his advice and assistance were most valuable. There was Mr. Peace, too. Both the latter gentlemen were in the Engineering Department of the University. Therefore so far as the Gas Company were concerned, the University had produced something more than gas. He should like to thank Dr. Stokes and the other gentlemen who were later on going to conduct the visitors round the colleges. Just recently, he added, the gas industry had been passing through anxious times; but looking round the faces of the gas engineers present, he saw no signs of special wear and tear. It had, however, been an anxious time. What was coming now, he could not say. But it seemed to him they would have to face the problem of dearer coal; and he was afraid the contracts for coal they would be able to make this year would be considerably higher than the contracts last year. A great deal of sympathy was shown to the men; but if the price of labour was going up, then the price of coal must follow, as well as the price of gas. Every shilling on the price of coal meant £1600 to the Gas Company; and it seemed likely that 2s. 6d. to 3s. extra would be asked. Such an increase would represent something like £5000. If it were so, it looked like an increase in the price of gas.

Alderman W. B. Redfern proposed the toast of "The Institution of Gas Engineers." He was reminded that it was fifty years ago since the Institution was formed; and it had been able to perform some wonderful work for the gas industry. It was partly due to conferences such as the one they had been holding in London that gas had reached such a commanding position, and knowledge of it had attained such a notable state. They had connected with the industry scientific men, celebrated chemists, and men of business. He had the honour a year or two ago to be present at a conference in London for the promotion of a gas publicity scheme. The conference had borne good fruit, and the public were being better informed as to the uses of gas. With such men as the President and Mr. Auchterlonie, the gas industry need fear no rival. He knew Mr. Shadbolt as one of the most able men in the gas profession. He (Alderman Redfern) had had the pleasure of meeting him so often that he could speak of his capabilities as a gas manager. He associated the toast with the name of Mr. Shadbolt. [Cheers.]

The President, in reply, said this was a proud moment in his life; and as those present had chosen to make this toast somewhat personal, perhaps they would permit him in responding to strike a somewhat personal note. This town of Cambridge was the one in which he first saw the light of day. [Cheers.] This was the town which had provided four Robert Shadbolts in four lines in succession, as managers of gas-works. This was the town the works of which were managed in the very early days—about 1825—by his (the President's) great-grandfather, followed by his grandfather; and his father and brothers were brought up in the Cambridge Gas-Works, and went forth from there into the world to make their marks, great or small. He and his brothers were the fourth generation in the direct line of gas managers of the family of Shadbolt emanating from the town. He had with him his two sons, both in the gas-engineering profession, and one of whom also bore the name of Robert, and he would be the fifth of the name in the direct line of succession. [Applause.] They would understand why this was a proud moment in his life. He had not the slightest doubt that the evolution of the Cambridge Gas-Works represented the evolution of the gas industry in this and some other countries. He proceeded to speak of the work of the Institution and of how it promoted the technical and commercial interests of the industry. As one looked back upon one's own association with the Institution, one was astonished at the progress of the amount of work that had been done by it, and at the increased usefulness it was rendering to the industry

and to those among whom its members lived and moved. So long as the Institution had objects such as these animating the members, the industry was bound to thrive. There was no industry that was served by its technical organizations so well as the gas industry was served by the Institution, the District Associations, and other organizations. He looked forward with confidence, knowing the Institution was on the right lines, and that they were interpreting aright the duty before them; and nothing but profit could possibly ensue. He proceeded to mention that they had with them that day the Hon. George Swinburne from Australia. This gentleman was largely instrumental in bringing about the first contribution to the funds of the British Commercial Gas Association that was sent from Australia. They would like to hear a few words from him.

The Hon. GEORGE SWINBURNE proposed the toast of "The Ladies." He said that in Australia they had every confidence in woman. In his own constituency, he had very nearly 12,000 women voters. They obtained degrees from the University; and they had lady doctors who engaged in research work and investigation. That day he was present representing the Victorian Gas Managers' Association, with which he had been connected from its start. In Australia some of the gas managers lived long distances apart—sometimes several hundred of miles separated them, and therefore they were glad to have an Association to bring them together. He had been engaged in pioneer work now for nearly thirty years in the Colonies; and although he had a home in Australia, he had always spelt England with a capital "E." [Laughter and cheers.] It was a great thing for him to be with his friends in the old homeland that day.

Mr. A. BROMLEY (Batley) was called upon by the President to respond for the ladies; and he did so with a brevity that could not have been excelled: "The Hon. George Swinburne, Mr. President, and Gentlemen, on behalf of the ladies, I thank you."

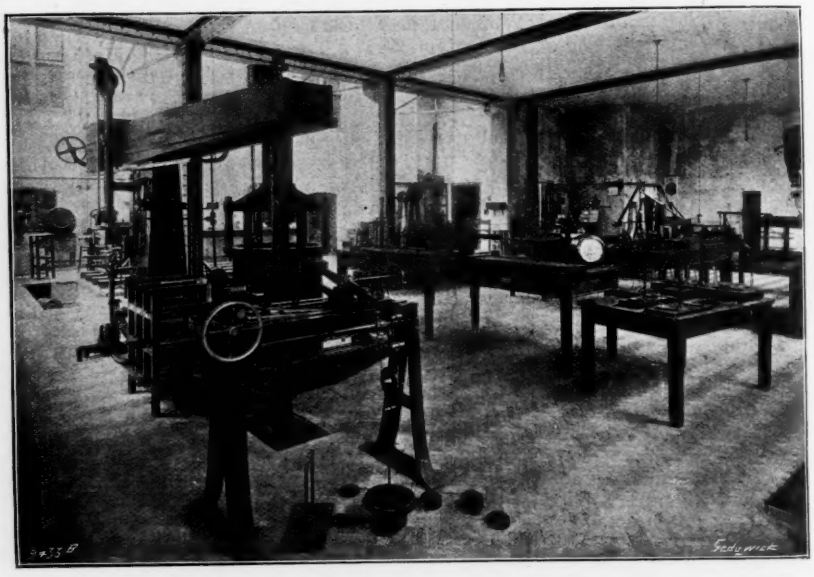
VISIT TO THE COLLEGES.

The large party then walked to St. John's College grounds, where, with the chapel as a background, they were grouped and photographed.

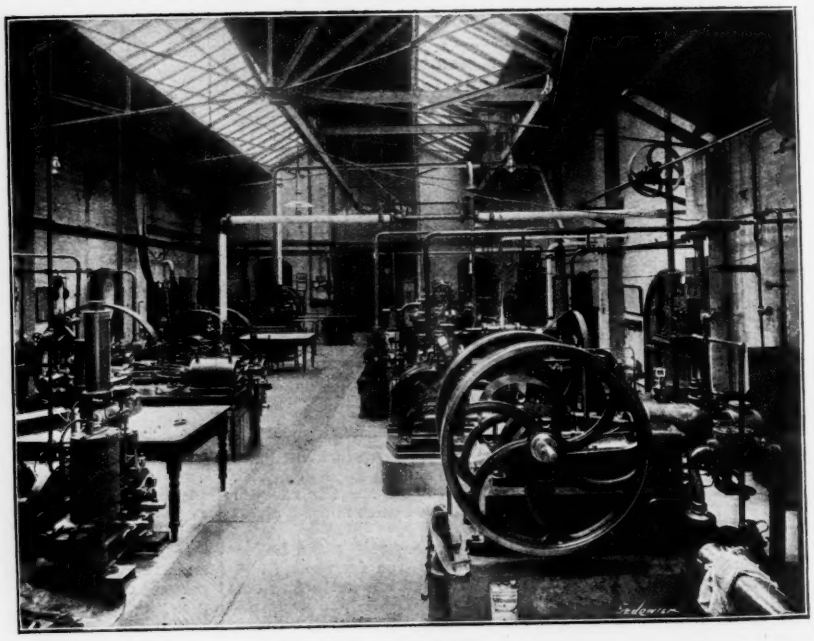
Afterwards, those who had signified their intention to visit the University Laboratories and the works of the Gas Company were taken away by their guides; and the remainder of the numerous party were allocated to the gentlemen who had kindly undertaken to escort them in their exploration of the famous colleges and their beautiful environment. Dr. Stokes, Mr. Morley, Mr. Macalister, Mr. Catling, and Mr. Heycock were indulgent guides. The chapel of St. John's was first visited, and then various parts of the College, including the dining-hall. The Bridge of Sighs was crossed to and along the backs to Trinity College. There the handsome library and dining-hall were inspected; and then in turn Clare College, the Gate of Honour, Gonville and Caius College, and King's College Chapel were visited. The parties, by the kindness of their guides, feasted on the architectural features and historic facts connected with the colleges, as well as the charming natural beauties of the environment of the latter. Some of the visitors also inspected Christ's College and Holy Sepulchre Church (Round Church).

THE UNIVERSITY LABORATORIES.

The party visiting the University Laboratories only numbered about twenty; but it was an interested party. The head of the department is Professor Bertram Hopkinson, M.A., F.R.S.; he being Professor of Mechanism and Applied Mechanics. As already stated, two of the Directors of the Gas Company are also associated with the work of the Laboratories—Mr. C. T. Heycock, M.A., F.R.S., and Mr. J. Peace, M.A. The laboratories and workshops were inspected with a vast amount of pleasure. Important parts are the engine-room and electrical laboratory. In the former there are twelve engines of small size. It is considered by Professor Hopkinson to be a wise policy to have several small engines of different types, rather than fewer larger ones—the principles involved being the same. There is a tandem compound engine by Messrs. Robey and Co., which will work up to 50 indicated horse power. There is also a single-acting, high-speed, compound vertical engine, of 25-horse power when running at 500 revolutions per minute. A third steam-engine is of the tandem compound type, and is of 11 brake horse power. This is coupled direct to a dynamo, and runs at 600 revolutions per minute. All the engines are so arranged that complete tests can be made to get out a heat balance-sheet; there being indicator gear, brakes, measuring-tanks, and the other usual testing appliances. There is also a small horizontal, simple steam-engine used for instruction in elementary principles. The



A View in the Testing Laboratory.



The Engine-Room.

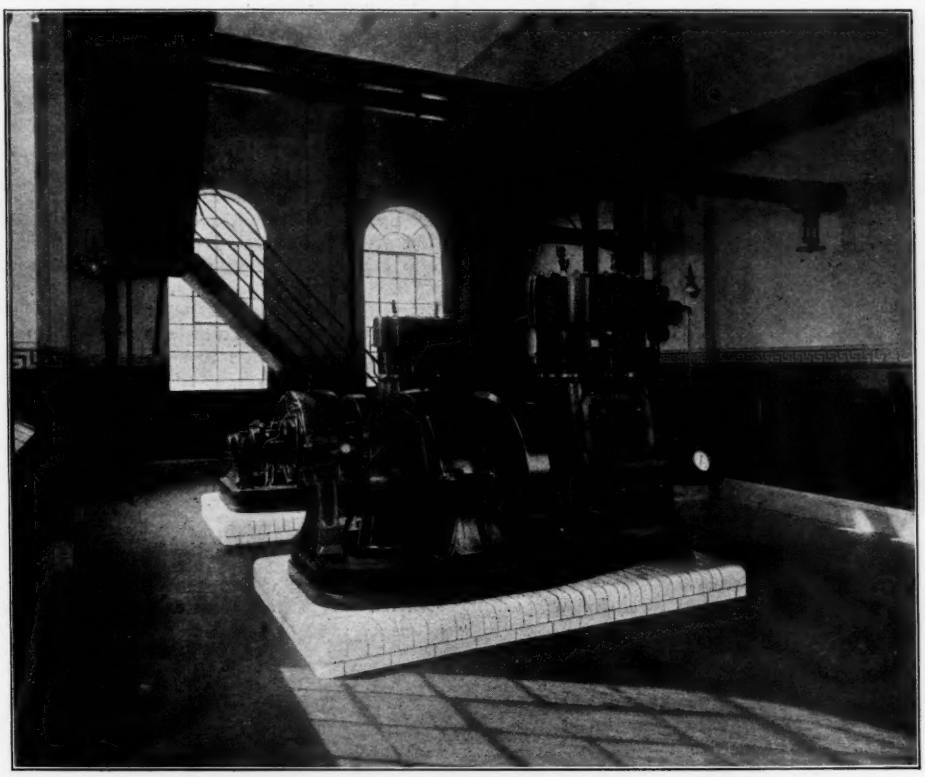
internal-combustion engines comprise a 5-horse power Hornsby-Ackroyd gas-engine, a small petrol-engine, a 10 brake horse power Forward gas-engine, and a Crossley gas-engine of 5 brake horse power. These engines are all used for experimental and instructional purposes; while a good deal of valuable research work has been carried on in connection with them. This has been much aided by the use of the Hopkinson exhaust-gas calorimeter, which is fitted to all these internal-combustion motors. There is also in the engine-house a 25-horse power high-speed Westinghouse engine, coupled to a two-phase alternator. This plant is used for generating current. At the

end of the engine-house is placed the department for the testing of electrical apparatus and machinery. The Electrical Laboratory, in another part of the building, is fitted up with the necessary appliances for both instruction and research in this branch of engineering science. The new section which was erected in 1900 commemorates the late Dr. John Hopkinson. The whole testing laboratory is well equipped. Among other things that undergo scientific examination here are engines sent by various manufacturing firms. The dynamo room contains a number of alternating and continuous current machines, but none of large size. Class rooms are located here (as well as in the older part of the building); and here, too, is the lecture theatre. The visitors were grateful for the attention bestowed upon them, and for the interest that was awakened by what was seen.

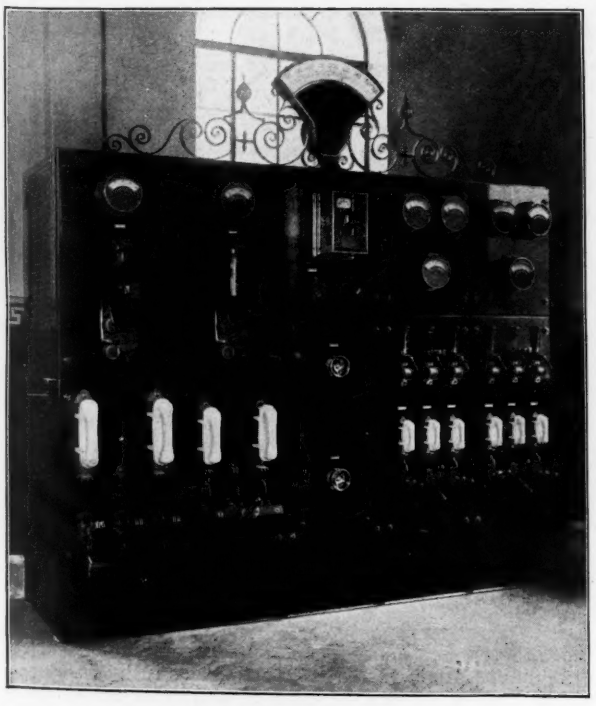
The Gas Company's Works.

The party paying a visit to the gas-works numbered about 24. There have recently been some extensions carried out here—in fact since Mr. Auchterlonie has been in charge, the works have been transformed; and the transformation has produced economy both for consumers and shareholders.

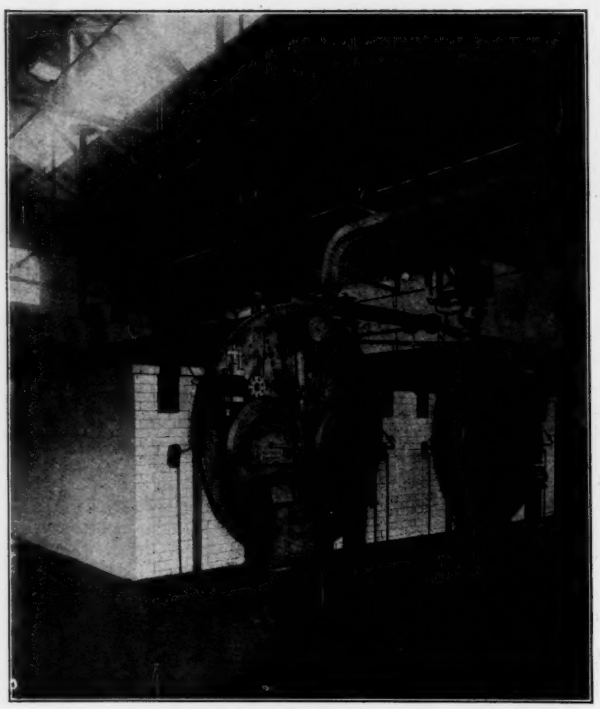
The works were described in our columns as recently as Sept. 27, 1910; and therefore the general particulars as to their capacity and character may be gathered from that article. But there have been further extensions; and these may be described. There is first and foremost a power-house, erected last year by Messrs. C. & W. Walker, of Donnington. It is a steel structure filled in with brickwork. In the basement, the boiler feed-pumps and exhaust steam feed-water heater are situated. The whole of the exhaust steam from the various engines will eventually pass through the heater; and, by this means, the temperature of the feed water will be raised to 205° Fahr. or thereabouts. The pumps are in duplicate, and capable of delivering 600 gallons per hour against a pressure of 150 lbs. per square inch. The ground floor is set apart for the engines, dynamos, and main switchboard. There are two high-speed steam-engines, coupled direct to the generators by Messrs. W. H. Allen and Sons, of Bedford. The engines are of the enclosed type, and work with forced lubrication at a pressure of about 15 lbs. per square inch. The compound wound dynamos, with interpoles, will develop 50 kilowatts and 75 kilowatts respectively at 220 volts. The main switchboard is by Messrs. Dorman and Smith, of Manchester, and is of enamelled slate, and comprises generator panels, shunt regulator panels, and circuit panels. Each dynamo is provided with an automatic reverse-current circuit-breaker, triple-pole switch for paralleling purposes, and double-pole fuses. Every circuit has an automatic overload circuit-breaker, and is also fitted with ammeter, single-pole switch and single-pole fuse. The volt meter above the switch-board is common to both dynamos; and there is also a wattmeter for registering the watts absorbed by the various motors throughout the works including, of course, transmission losses. A 2-ton travelling crane is erected overhead for lifting any part of the engines or dynamos when required.



In the Power-House at the Cambridge Gas-Works—The Dynamo Room.



The Switch-Board in the New Power-House at the Cambridge Gas-Works.



The New Boilers at the Cambridge Gas-Works.

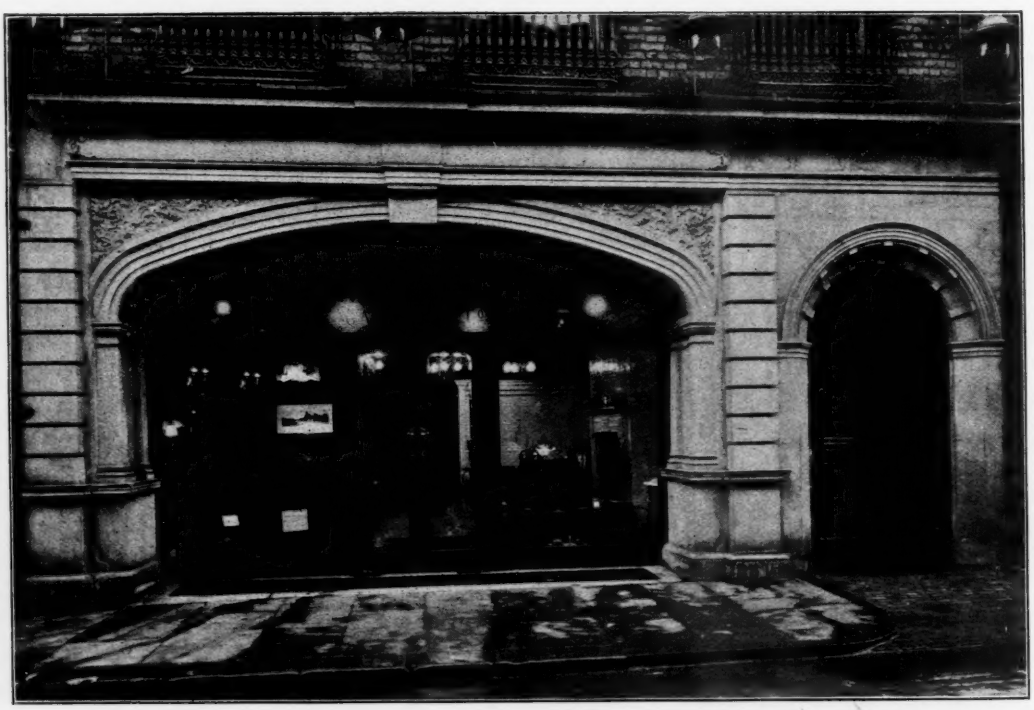
In the first floor there is a softened water storage tank, with a capacity of 6000 gallons; and a water-softening plant capable of treating 600 gallons an hour, it was gathered, is about to be put in by Messrs. Lassen and Hjort, of London. The main water storage tank forms the roof of the structure, and holds 25,000 gallons. A three-throw pump erected in the adjoining pump-house delivers water into this overhead tank from a well sunk in the works, the depth of which is about 70 feet. A centrifugal washer by Messrs. Kirkham, Hulett, and Chandler (capacity 3,000,000 cubic feet per day, and electrically driven through mitre-gearing) has been recently installed, as also a Pelouze and Audouin tar-extractor by Messrs. Holmes, of Huddersfield. One of the gasholders is at present being fitted with an additional lift, which will be a flying one. The existing guide-framing of the holder is sufficiently strong to take this extra lift; and no alterations will be made to it, except that trumpet-shaped channels will be fixed on the top of the present guide-channels to receive the rollers on the carriages of the new lift as they descend.

A Tea and Votes of Thanks.

There was no one, we think, among the large party who spent the afternoon sightseeing in the manner described who could say "No" to a cup of tea, and it was a thankful party—ladies and gentlemen—who found themselves back at the Guildhall about 4.30. They were the guests at tea of the Chairman and Directors of the Gas Company; and the Chairman and his colleagues (already named in connection with the luncheon) were there to receive their guests. The tea was thoroughly enjoyed. Then the President, in his usual happy and apt style, proposed a vote of thanks to the Chairman and Directors for their hospitality. The Chairman responded, and hoped that it would be the good fortune of Cambridge to see their visitors there again on some future occasion, when he hoped that at the gas-works there would be something more that is new to show them. Then there was a vote of thanks to the amiable Dr. Stokes, and the other gentlemen who had kindly escorted and instructed the parties during their tour of inspection. Dr. Stokes made genial reply.

Homeward, and to the Daily Task.

Hosts and guests soon afterwards separated. Motor vehicles were boarded; and the station was reached. Adieus were said to Mr. and Mrs. Auchterlonie and others who accompanied the visitors to the station. The journey was smartly accomplished in the special train; and as we passed through the beautiful country conversation flowed freely. Liverpool Street Station was reached soon after 7.30. Then there were the usual annual partings; and once more many immediately passed from the week's rush of engagements with numerous professional and other friends into the old world where, in different spheres, duty and responsibility awaited them.



The Cambridge Gas Company's Show-Rooms.

GENERAL REPORT.

The Annual General Meeting of the Institution opened last Tuesday, at the Royal United Service Institution, Whitehall—Mr. ROBERT G. SHADBOLT, the Engineer, Manager, and Secretary of the Grantham Gas Company, the President, in the chair.

Confirmation of the Minutes.

It having been moved and seconded that the minutes of the last annual meeting should be taken as read and adopted, the President signed them.

Appointment of Scrutineers.

On the motion of the PRESIDENT, seconded by Mr. J. FERGUSON BELL (Derby), Mr. W. S. Morland (Gloucester) and Mr. E. A. Harman (Huddersfield) were appointed Scrutineers.

Annual Report.

[See "JOURNAL" for May 28, p. 572.]

The PRESIDENT: It falls to my lot, more as a matter of form than anything else, to propose the adoption of the Council's report for the past year, 1911-12, of which you have all received a copy. I will not attempt to elaborate the report at all. I have no doubt there are many items of interest to various members; and, though we do not court, having regard to the business before us, a long discussion on the items raised in the report, still there is so much of interest contained in it that if any gentlemen have any remarks to offer which are particularly to the point, we shall be glad if they will make them in the briefest possible manner. I propose the adoption of the report.

Mr. BELL seconded the proposition.

Mr. GEORGE HELPS (Nuneaton): I beg to move, as an amendment—"That the report be referred back to the Committee." I do this for three reasons—one is, that nothing has been done with regard to widening the Institution's door; secondly, proper care has not been exercised in the awarding of the medals for papers read last year, as instanced in the case of Mr. E. W. Smith; and, thirdly, that nothing has been done in the way of rewarding work. It is all very well for the Council to say it is not advisable to make any alteration in the constitution of the Institution at present. When will it be advisable? How long is a handful of men—for this is only a handful of men in comparison to the numbers engaged in our industry—chiefly engaged in the manufacture of gas, going to pretend to represent the huge industry which we know exists? Where should we be to-day without the men who are more particularly responsible for the distribution of gas? The manufacture to-day is purely a mechanical process. We do not put a penny in the slot, but we put coal in, and we get gas out. That is about all it amounts to. When it comes to the distribution of the gas, and the uses to which it can be put when properly installed, we have matters which require ability, skill, and perseverance. In my opinion, our Institution should be open to everybody interested in gas, whether as workers, controllers, or investors. If the Institution does not do something in this direction now, it never will do it. I am not passing any vote of censure on the work of the Council. The work the Council has done is unquestionably good, and every member has worked hard during the past year; but, in my opinion, the Council wants reconstituting. It is necessary to represent the gas industry to-day in a totally different manner from what has been done in the past. The various sections require to be divided up, and a competent Chairman put in charge of each. With regard to the award of a medal to Mr. Smith, I need not tell any gentleman here, much less Mr. Smith himself, that in my remarks there is nothing of a personal nature. I stand up to speak on the matter simply because all you other gentlemen are sitting down; and I know very well if I do not speak on it, no one else will do so. I can quite understand the difficulties that beset the Council when they come to award prizes for papers, particularly when the "sums of all the boys are right." But this is my point, gentlemen: When the sums on one slate are unquestionably wrong, is a prize to be given to that boy over the heads of the other boys, just because he has attempted to work it out in another way, and he has an answer which is obviously wrong? Now you will say "Reference." I give you the reference. If I am wrong, I only hope that some other gentleman here will put me right. Mr. Smith has it that with gas at 15 inches of mercury he got 92 per cent. of efficiency, and with gas at 25-10ths of an inch of water he got 47·5 per cent. If this is not obviously wrong, gentlemen, then I know nothing about gas efficiency and I know nothing about high pressure; and I am in the same predicament that it seems to me the Council were in when they began to discuss this paper.

The PRESIDENT: I hope you will not discuss the paper, Mr. Helps.

Mr. HELPS: No; I only thought you would like to have the references to the paper, as showing why I say the award was wrongly made. Mr. Smith has done very excellent work. I take it that the award is for the paper alone; and, therefore, on the paper alone he should be judged. That is all I have to say with regard to that. Now as to the award for work. When I mentioned this matter last year, at Glasgow, I thought a good many of the gentlemen now present were in favour of the worker being shown some appreciation for his work. Nothing has been done. We are continuing to reward the talker, the man who says so; but we continue to neglect the worker, the man who does something. With these remarks, I beg to move that the report be referred back.

The PRESIDENT: Does any gentleman second Mr. Helps's amendment?

Mr. C. E. JONES (London): I should like to offer an observation or two; but I do not think that any good would result from referring the report back, or I would second the amendment of my honourable and able friend.

The PRESIDENT: Then you do not second the amendment?

Mr. JONES: No; I do not second it, but I should like to offer a word or two on the report, if I am in order.

The PRESIDENT: First, does any gentleman here second Mr. Helps's amendment? [There was no response.] As no one seconds it, you are at liberty to speak to the report, Mr. Jones.

Mr. JONES: It is no new thing to hear an appeal for a widening of the basis of the Institution. I myself made an appeal in this room some twenty years ago or more; but it was considered at that time to be quite impossible, though I succeeded in getting two years longer for its consideration. While I have some sympathy for Mr. Helps in this matter, I do not think any good will arise from debating it on this occasion. I do not intend to traverse the report; but since I came into the room I find an addition has been made to it* having reference to the labour troubles in this country, which are now assuming a very important and disastrous appearance, the results of which in the future we can scarcely surmise or anticipate. The addition to the report refers to coal—the fundamental material which makes the finest and most varied artificial light in the world, and probably also will take the place of steam for power in time to come. The solution of the difficulty with regard to strikes in gas-works consists largely in the proportion of coal taken during the year. If you can take coal in equal monthly quantities, which in some cases would be hard on the manager, and perhaps would not be desirable, you would provide a weapon to the coalowner which would largely obviate the necessity for strikes. Some years ago, in debating this question, I raised the point; and I found that in many instances the gas manager of that day asked for coal from the colliery proprietors in such quantities as he liked. He gave no percentages, he gave no monthly deliveries. There were at that time something like a dozen gas managers in this country who were quite prepared to take coal from hand to mouth from the collieries instead of dealing in some give-and-take fashion, and take the coal, as possibly some of them could, in much larger quantities. I see the quantity recommended in the addition to the report now is 40 per cent. in summer and 60 per cent. in winter. As to how this is arrived at, there is no information before me; but I think the difference between 40 and 60 per cent. is far too great. If, Sir, you would withdraw this addition to the report, and appoint a Committee to go into the question very fully, you would find that a great deal can be done by the Institution to minimize the effect of strikes by endeavouring to take coal in more equal monthly quantities. I do not know whether you insist on this addition being made to the report, because it has not been circulated until this morning, and I very much question whether it is in order to circulate it.

The PRESIDENT: Do you propose its deletion?

Mr. JONES: I think I will. Do you insist on it?

* See *ante*, p. 716.

The PRESIDENT: Yes.

Mr. JONES: Then I second the adoption of the report with the deletion of the leaflet as to strikes.

The PRESIDENT: The adoption of the report has been moved and seconded. [To Mr. Jones:] Do you move the deletion of it?

Mr. JONES: I do not suppose there will be much chance of passing it. I have been on the Council myself, and I do not think it is of any use attempting to pass that; so I will leave it where it is.

The PRESIDENT: Gentlemen, I would briefly explain at this stage the way in which the addition came about. The question of strike clauses has agitated the minds of many of us, and from various quarters of the country the Council have been approached with the view of drafting a general clause which would be applicable with regard to the purchase of coal and the sales of residuals, and also with regard to the sales of gas. It is a very knotty question, and it is one with which the Council are not in a position to deal. When I explain to you that this clause which is added to the report, and which the Council wish to form a portion of it, is a clause which has been arrived at between the coal buyers and sellers in Lancashire, and very largely adopted in Yorkshire, you will see that Mr. Jones's point, that it has not received consideration, falls to the ground. It has received, to my knowledge, very full consideration over a number of years. As this is the only agreed clause that the Committee knew of, they recommended it to the Council, who took the line of adding it to the report rather than that it should stand over for another year. It is only a suggestion of your Council; and to their mind it is a most suitable general clause. Now we have no amendment at all before the meeting. There are several other points arising on the report, and one in particular which I think you will all agree is of extreme importance. It is the proposed specification on street lighting. The Council have invited Mr. Abady to address a few remarks to the meeting on this point, he being the greatest authority on street lighting.

Mr. JACQUES ABADY (London): Mr. President, I only rise because you specially directed your invitation to me to do so; but at the same time I welcome the opportunity given to me of saying a few words on what may be considered an interim report on the standardizing of street lighting which is contained in the report of the Council. The matter, as far as I understand it, stands like this: A Joint Committee has been got together (I do not know exactly on whose initiative), and it consists of representatives of the Institution of Electrical Engineers, the Illuminating Engineering Society, and the Institution of Gas Engineers, and they have been working with the idea of getting out a standard of street illumination, the inherent form of which shall be that the purchase and sale of public lighting shall be on the basis of illumination. Various propositions apparently have been put before the Committee, and they seem to have come to the conclusion —and, reading between the lines, I believe it must have been against the representatives of the Gas Institution— that the proper method is a specification of the minimum illumination on a horizontal plane at the height of 3 feet above the ground level. I want you to consider for just one moment what this means. Of course, I can only offer a word of suggestion, because my sphere of life does not permit me to be a member of this Institution, and, therefore, I can only offer what appear to me to be criticisms from an outside point of view. But I put it to you, gentlemen, that the specification of the minimum illumination of a street by no means conveys a proper measure of the illumination in that street; nor does it convey a proper measure as between one form of illumination and another. To begin with, the first point, as I said, is that the specification of minimum illumination does not convey an adequate idea as to what is the illumination in a street. You may specify a minimum illumination of 0·1 foot candle, and anybody could comply, by a certain form of lighting, with that minimum, and yet the lighting might be disgraceful. On the other hand, another form of lighting might only produce a minimum illumination of 0·05 candle, and be ten times as useful, and, as would be obvious to anybody, give much better street lighting than the one with 0·1 foot candle minimum illumination. Under these circumstances, it seems to me—and I say it with some amount of dogmatism, and at the same time with the diffidence of a guest of this Institution, speaking at the meeting—that there is no good in "footling" with the question by going on with the matter, or by having anything to do with a Committee which know so little of the subject it has to discuss that it can confidently suggest that the specification of a minimum illumination is any guide as to what the relative lighting between one street and another may be. It seems to me that it is like specifying to a decorator, when you want to give him an idea as to how you wish your drawing-room decorated, that the paper in the servant's bedroom should cost 9d. a piece. The minimum illumination does not tell you what the illumination is going to be all over the street. So much for this form of expression not being a guide to the lighting. As regards it being any guide or comparison between one form of lighting and another—say between arc lighting and low-pressure gas lighting—I want to point out how absurd it is. Supposing you have a light and put it on a post 9 feet high, and also an arc lamp and put that on a post 20 feet high, even supposing the minimum illumination 3 feet from the ground is so much, it does not say that the light is the same. If the light is 9 feet from the ground, and you take 3 feet off, seeing that the minimum illumination is a factor of the square of the distance of the photometer from the source, you can quite see that 3 feet taken off 9 feet is going to have a detrimental result on the photometer reading of a lamp that is on a low post. That is to say, the difference between the square of 23 and 20 is relatively less than the difference between the square of 6 and 9. So that I am perfectly convinced that you cannot judge of the relative value of one source of illumination and another by any other method than by associating the reading of the photometer and the expression of the illumination with the initial candle power of the lights, the distance they are apart, and the heights at which they are placed. For instance, going back to the minimum illumination, a street might be very well illuminated indeed; but there may be some dark patches, and so on, from the shadow of a post. Therefore, that is not any guide. You cannot get away from physical facts. The only way to do so is to assume what is a fact—that the light from any source will go in zones concentric with the source; and you can make the measurement of the illumination at certain distances from the source or at certain angles. Then the minimum illumination omits the diversity factor. Everyone knows that it is not so much the actual power of the light as it is the contact with the light in one part of the street and in another. I have put the matter as briefly as I can, though I have been longer than I intended to be; and I do suggest, with great respect to the Institution and the Council, that if this stupid illumination specification is persisted in, the only thing gas engineers have to do is either to write a minority report or withdraw, because this is unscientific and an inexact method of expression. I see that the Institution of Municipal and County Engineers have been asked to visit typical streets for the purpose of classifying them. This seems to me to be a lame procedure. It is all very well to talk about illuminating engineers; but there are only two classes of people who understand what illumination is. One is the man who has to sell gas for lighting, and the other is the electric light man; and I do not think either of them cares to go to a municipal or county engineer. You cannot dogmatize upon that. You have the different standards of lighting, if it is a big shop or a road, and so on. So that it seems to me that the Committee on which your representatives sat have got into a rather hopeless mess. It will be quite understood by my friends on the Committee that I make these remarks without any disrespect to their efforts; and I believe, if the truth were known, it would probably be found that they have been meeting on the lines I have suggested, and have found themselves in a minority.

Mr. S. B. LANGLANDS (Glasgow): I think that the position Mr. Abady has taken up is a lame one. The whole subject is bristling with difficulties. The question of getting value on streets is a very keen one, and there are many strong opinions on the matter; for instance, whether or not photometric readings should be taken. I have lately been taking photographs at night of illuminations, and many things have been brought out. On a wet night, on taking photographs, the results were enormously enhanced. Then when taking photographs of buildings of a light grey colour, as against those of a dark colour, the results are entirely different. A large room should be set apart for the testing of all lamps under similar conditions. Testing in the streets is, to my mind, of no value. This subject is bristling with interesting problems, and no one knows it more than my friend Mr. Abady. What I feel is that the Institution should move in the matter. You must remember that, after all, street

lighting is one of our best advertisements; it is of tremendous value to us as gas engineers. There is one point further to which I should like to refer, and it is perhaps a little away from the subject. Last year I made a statement with regard to the efficiency obtained from high-pressure lighting. Now I am in a position to make a complete *amende honorable* to my friend Mr. Smith. I have lately been associated with some tests made with Mr. Grafton, and we have obtained close up to 60 candles.

The PRESIDENT: I should like to explain at this stage that our reason for asking Mr. Abady to address us on this subject was that, as you will notice in the Council's report, the references to the street lighting are not in the form of a recommendation as to future action. It is only a kind of interim report as to what has taken place; and at the present time, in addition to this, your Council are in possession of a more definite recommendation with regard to proposed clauses for a standard specification, and they certainly do feel, to some extent, that they are being rushed. It is with a view to the members of the Institution, and also those of the Council, understanding the subject a little better than they did previously that Mr. Abady was asked to speak. You will understand that your Council are not recommending that anything contained in the report should be adopted; they are very much more alive to the position than they would like to admit. But we have a feeling that the matter has been rushed upon us to some extent; and possibly the suggestion made by Mr. Langlands will go a great way in directing the Council in their deliberations. Therefore I wish you to understand that we are not making a definite recommendation with regard to this matter. I will now call upon Mr. Thomas Glover to address you.

Mr. THOMAS GLOVER (Norwich): I think the members will agree that it would be a pity for the report to go through without some opportunity to emphasize and support what the President and Council have done in regard to the action of the Alkali Manufacturers' Association in opposing Gas Bills. Many of you have returned answers to the questions issued, and no doubt in your replies you have emphasized your feelings on the matter. But it is still under the consideration of the parliamentary authorities, and an expression from this meeting may do some good in convincing the authorities that we feel very strongly about the action of the alkali manufacturers in endeavouring to obtain a monopoly, and thus prevent us having free trade. The matter bears very unevenly and very unfairly on a number of gas companies and gas undertakings who are in a position to help or to be helped by their neighbours in the purchase and sale of residual products. Some works can with advantage buy tar from a small neighbouring works because they have the larger works as a distillery; and probably the alkali manufacturing works would be at a considerable distance, and the carriage of the material would bear very hardly on the small undertakings. This is only one instance of many where this matter, if it is allowed to go on as it appeared to be going on a few weeks ago, would be very unfair to the interests we represent. I am sure I need only call your attention to the matter to obtain an expression of feeling and a decision to support the President in every way you can in the action that has been taken in order to influence the parliamentary authorities in this matter.

Mr. E. H. HUDSON (Normanton): I think this matter is perhaps one of the most important that comes before the meeting. We scarcely know to what extent this combination will go if the manufacturers are not checked by representations from the profession generally. The way in which they have got the clause referred to in the report introduced into Bills passing through Parliament only shows the subtle manner in which the whole thing is being worked. We all know how difficult it is at the present time to get competitive prices for tar and liquor, and to get sulphuric acid, except, perhaps, from one particular works. If the restrictions in the clause are put upon us, this strong combination, which is probably one of the strongest in the world, will be made still stronger. There is one fact which I think the Lords' Committee do not seem to have appreciated, and it is this—that the penalty is not only on the gas company, but is eventually on the gas consumer. It is for us to use our efforts; and, from what has taken place since representations have been made by the Council, I believe these efforts will be rewarded by success in putting an end to this protection of a great industry at the expense of our own. I hope, as Mr. Glover suggested, that you will unanimously pass a resolution to confirm the action of the Council, so as to strengthen the representations that have been made by them. The question is under consideration at the present time. No definite result has been obtained, and probably any action taken such as is suggested will reach the ears and eyes of those concerned, and strengthen the case which has already been made.

Mr. R. W. EDWARDS (Aldershot): I should like to say a few words in support of Mr. Glover. I feel very keenly on this subject, because I know it bears very hardly on the small gas companies in the country districts, particularly where the difficulty exists that has been brought about by the various public authorities for the disposal of the effluents of sulphate of ammonia. I know a good many companies in the South of England who are not only too small to manufacture sulphate, but if they wished to dispose of their effluents cannot do so. This prohibitive provision put in a Gas Bill and passing through Parliament will prevent these companies disposing of their liquor to their neighbours, and so wipe out entirely a considerable proportion of their revenue. This, as has been pointed out, will bear very hardly on the consumers of gas in the poor districts. I think of the two the question of sulphuric acid is more important than that of the tar, because we know that in recent years the disposal of tar for use on high roads is a much simpler matter than it used to be. I hope the next time the matter comes before Parliament that the authorities of the House will be convinced that this provision should not be inserted in any Bill. There is one other point to which I should like to refer, and that is the proposed strike clause. It seems to me quite a satisfactory clause from the companies' point of view, and one which one would imagine would be amicably agreed upon between buyer and seller when the dealings take place direct between the buyer and the colliery. But, as a good many know, particularly in the South of England, this is not the case. We are to some extent bound to purchase our Durham coal through factors in London; and I cannot quite see them agreeing to the following words: "The gas authority shall, within a month after the cessation of such disability, determine whether they require the quantity short-delivered owing to such disability to be cancelled or to be delivered." It reminds me very much of the old adage, "Heads I win, tails you lose." From my experience, I do not think you will get the factors to agree to the clause. I should like to ask you, Mr. President, whether the point has arisen. I know there are gentlemen on the Council who have the experience I am speaking of now; and perhaps you will tell us whether this point has been considered with respect to the London Companies. I cannot quite see, on a falling market, a factor holding up (say) 10,000 or 20,000 tons of coal in the hope of the buyer taking it, and then finding himself landed with a quantity at a higher price than that at which he has to sell on a low market.

The PRESIDENT: Perhaps I might dispose of Mr. Edwards' remarks at this stage by pointing out that what the colliery proprietors will be agreeable to do there is little doubt the factor will be agreeable to do, because he is simply passing on his responsibility to the colliery proprietors. The factor's responsibility would be handed over to them.

Mr. EDWARDS: Do you not think the Durham market somewhat dissimilar to other markets? Durham colliery owners insist on a somewhat different strike clause.

The PRESIDENT: This is only a recommendation on general lines, as near as the Committee can come to the requirements, and not specifying any particular coalfield.

Mr. EDWARDS: My point was whether you had consulted or taken some evidence from other markets.

The PRESIDENT: I think we have been pretty well over the whole ground.

Mr. SAMUEL GLOVER (St. Helens): I rise to refer to the action of the alkali manufacturers; and I move that the Council be asked to proceed with the work they have been doing, and take every step to protect the interests of gas companies and gas authorities in this matter. I think this resolution, if carried, will be a vote of confidence. It will express our confidence in the action of the Council so far, and be an expression of our thanks for the able manner in which the question has been dealt with. I move that the Council be instructed to proceed with this matter in defence of the interests of gas authorities.

Mr. D. T. LIVESEY (East Grinstead): As representing a small Company, I should like to make a recommendation. I found a neighbour of mine was getting sulphuric acid from the makers at 15s. a ton less than I was buying it for myself.

They asked me 22s. 6d. more than the price at which they were supplying it to my neighbours. The result was that I presume my contractors found out what I was doing, and they put on an extra 5s. I had to buy at an enhanced figure by reason of trying to get it at a reduced price, presumably because of the "ring" of makers. I afterwards found that by approaching one of the large gas makers I bought my sulphuric acid at some 20s. less than he was supplied at. I think this shows that we are rather under oppression if we allow this arrangement to go forward, and leave the matter entirely in the hands of the sulphuric acid makers. I have still another case with reference to the supply and sale of ammoniacal liquor. The contractors would only pay for the liquor on the condition that it was of 7-degree strength (14-oz. liquor); and if the liquor was a little below this, they would not pay anything. It so happened that 6d. a barrel had to be paid on the rail; so that the Company lost 6d. a barrel on the transaction. Instances like this show that we have a real case against these makers; and I heartily support the suggestion of Mr. Glover, on the ground of the oppression that is by the arrangement being brought to bear upon the small companies in country districts.

The PRESIDENT: I do not wish to curtail discussion unnecessarily, but if there are any other members who have experiences for which they can vouch, similar to those of Mr. Livesey, that is the kind of comment we desire on the clause. Similar experiences would prove a valuable line of action for the Council to go upon. [There was no response.] Then, gentlemen, I take it that you have said practically all you wish to say on this point. I know there must be numbers of cases, and there must be members whose evidence would be very valuable; but we must move along. Possibly it would save a little time if, instead of waiting for further discussion, I were to state the position, which is that this afternoon, at five o'clock, a Joint Committee, consisting of representatives of the Council and the Gas Companies' Protection Association, will sit to fully consider what steps should be taken with regard to a case which will apply to the general gas industry of the Empire. After the meeting, if it is deemed necessary to bring the matter before you by way of asking your commendation of any action which has been taken, it will be done. The motion before the meeting is—"That the report as submitted be adopted."

The motion was carried unanimously.

The PRESIDENT: Arising out of the report and the remarks which have been made with respect to the action of the Alkali Manufacturers' Association, I will, by way of interpreting your feelings, put this resolution: "That this meeting is of opinion that the action of the alkali manufacturers in endeavouring to prevent unrestricted trade in the manufacture and sale of the residual products arising from gas manufacture is opposed to the interests of gas consumers. It heartily approves of the action of the Council in bringing the matter before the authorities of Parliament, and is of opinion that every endeavour should be made to oppose any curtailment of the powers possessed by gas undertakings in dealing with their residuals."

Mr. THOMAS GLOVER: I beg to second the resolution, which expresses rather more freely than I tried to do the idea of the next step we ought to take. I suppose, in carrying out this instruction, the Council would be prepared to receive instances communicated to them in writing by any member, such as you have asked to be given.

The PRESIDENT: Before putting the resolution, I should like you to know that, in response to the circular we issued, we received upwards of 700 replies, many of them being exceedingly interesting. But there were 1600 inquiries sent out; so that a great bulk of them yet remain unanswered. If any gentleman present has an interesting case which has not yet been brought before the Council, it will still be of value to us.

The resolution was carried unanimously.

Presentation of Awards.

THE "LONDON" AND INSTITUTION GOLD MEDALS.

The PRESIDENT: The next item is the presentation of medals. The first will be the presentation of the "London" Gold Medal, which has been awarded to Mr. Charles Dru Drury for his paper, read at the Glasgow meeting last year, entitled "The Dessau Vertical Retorts at Sunderland." Mr. Drury, I have great pleasure in presenting you, on behalf of the donor, Mr. H. E. Jones, with this medal, which Mr. Jones has agreed to continue to present for a further term of years. Mr. Jones lays down certain conditions with regard to the awarding of this medal, which are that it shall be chiefly for a paper devoted to engineering work; and the more individuality there is with regard to that work the better is the donor pleased. The Council, with whom the duty of awarding the medal is left, decided that you were entitled to it on account of your paper and the records which I think I may say you have so faithfully portrayed in it. At the same time, I may offer you my hearty congratulations on the fact that you are the first member of the Institution to receive for the same paper two recognitions in the form of two gold medals. The Council have felt that, valuable as is the "London" medal, circumstances do arise where a paper which meets its conditions may not possibly be the best one as a paper on its merits entirely. Consequently they decided, after due deliberation, to add a gold medal to the silver and bronze medals; so that, quite independently of the "London" medal, the Institution has now its first, second, and third awards. I have pleasure in handing to you, Mr. Drury, who, in the opinion of the Council have richly deserved it, the first gold medal of the Institution.

Mr. C. DRU DRURY (Sunderland): Mr. President and gentlemen, I scarcely know how to convey my thanks to the Institution for the very high honour they have conferred upon me on this occasion. I can only say I very deeply appreciate the awards they have assigned to me, and I would state that this will indeed be a red-letter day in my life. As a matter of fact, I must admit that I was overwhelmed when the communication was sent to me that I was to receive both of these awards. I cannot realize absolutely that my paper in itself merited such high recognition; and I feel that I must assume that it is very largely due to the excellence of the system which I had the honour of dilating upon at the last meeting. It is a great satisfaction to me to think that my efforts last year have added to the interest in the "Transactions" of the Institution; and it would be a still greater satisfaction to me to hope that anything I may have done in this direction has benefited the technical knowledge of the profession generally. Mr. President, I beg to thank you also for the kind remarks you made personally to myself.

THE SILVER MEDAL.

The PRESIDENT: The Council have awarded the silver medal to Mr. E. W. Smith, of Birmingham, for his paper on "The Uses of High-Pressure Gas for Industrial Purposes." Mr. Smith, it affords me great pleasure, on behalf of the Council, to present you with the Institution's Silver Medal as an award for the paper which you submitted to the meeting at Glasgow last year. I think possibly the remarks made by Mr. Helps will, if anything, have added to the lustre of this medal. They were made undoubtedly in good part; and I have no doubt they will be received in the same spirit. In offering you this token of the appreciation of the Council, I may say to you, as a young man, that this is not only their recognition of the valuable work you have done for the industry up to the present time—it is all that—but, in addition, may I ask you to look upon it as an expectation from the industry of the valuable work that you will perform on their behalf in the future? The Council take a wider view of the question—that this is the smallest possible way in which they recognize those services which to them may appear, and possibly do appear, of much greater value than they do to yourself. I have very great pleasure in presenting this medal to you.

Mr. E. W. SMITH (Birmingham): Mr. President and gentlemen, as a young man, I feel greatly the honour that your Council have done me in presenting to me, at such an early age, your Silver Medal. I assure you I appreciate their action when I tell you that in the early days (for me) when I decided to take up technical research in the gas industry, a well-known professor said: "Mr. Smith, you must realize that it is very *infra dig.*, or is considered such, to work on that line. If you are out for doing something exceptional, do it; but if you want to keep (say) in the tone of scientific work, you will not go into that type of work." This was said in all good part by that professor, and was meant for good advice. Since then I have found out that scientific research has been all that I crave for; and I am glad that I came into the gas industry. I assure you that any little work that I have done on high pressure is only a hint of what can be done with gas under pressure; and the future will show, by what is being done in London, in Birmingham, and in other parts of the world, that high-pressure work, especially for metallurgical purposes, will

hold its own, and will be better than any other form of gaseous heating that is at present being talked of. I assure you I thank you very much for your medal.

THE BRONZE MEDAL.

The PRESIDENT: The third award is made to Mr. J. G. Newbigging, of Manchester, for his paper on "The Scientific Carbonization of Coal." Mr. Newbigging, I am afraid, is prevented from attending to-day. As he is absent, I must hand the medal to him privately on the first opportunity that offers.

President's Address.

The PRESIDENT then delivered his Inaugural Address, which was given in the "JOURNAL" last week (p. 698). At its close,

Mr. JOHN CARTER (Lincoln) said: Gentlemen, I have been requested to submit to you a resolution, which, judging by the hearty applause which greeted the President's address, becomes absolutely unnecessary. But it has become our practice to record our appreciation of the Presidents' utterances at our annual meetings; and I am quite certain that this is one of those occasions on which you would not like the formality to pass unobserved. A great many who know the President have, I am quite certain, come this morning expecting to hear something outstanding in the nature of an address. Those who know him better probably raise their expectations still higher. But I am free to say, without any reservation whatever, that the most exacting demands of his friends have been fully met in the address we have listened to. It has often been said during recent years that it becomes increasingly difficult to present a presidential address that shall contain any new features, or that shall have in it any items of peculiar interest. As the President proceeded, he gave us a very clear instance of how easy a very difficult task becomes when it is approached by a master mind. I like the tone of cheerful optimism which runs through the address from first to last—an optimism that is not forced, but is absolutely justified by every fact of the situation to which the President has directed our attention. It reminded me of what we are told concerning Sir Isaac Newton—one of the great men intimately associated with Grantham. After a life that was luminous, which formed an epoch in the intellectual progress of our race, you will remember that, at its close, when he looked back upon all his achievements, he told us he was just like a child on the seashore picking up a pebble here and there while the vast ocean of knowledge lay before him. The closing sentences in the Presidential Address embody a sentiment such as that. It reminds us of what has been done; and it also reminds us that during the history of the past hundred years, although much has been accomplished, it lies before us to make the future still more fertile, still more productive in everything that is in the interests of our industry and the public service. I am quite certain that, in submitting the resolution of thanks to the President for his interesting address, I shall carry your feelings with me when I say that, in a year of presidency into which he has thrown untiring energy, boundless enthusiasm, and capacity, he has brought it to a fitting climax by the address he has delivered this morning.

Mr. JOHN BOND (Southport): I have very great pleasure in supporting all that Mr. Carter has said about our President. I congratulate him, as, no doubt, you all will, on his very able address, which bristles with scientific thought, suggestions, and advice. With these few words, I sincerely congratulate the President, and have great pleasure in seconding the resolution.

Mr. Carter put the motion; and it was carried by acclamation.

The PRESIDENT: Mr. Carter, Mr. Bond, Ladies, and Gentlemen (for I notice that the ladies joined in the applause), may I tell you a little story? Last night it was my lot to be one of a number who were entertained by the "Evening Star" Lodge of Freemasons; and on leaving a most enjoyable function, I was invited by several gentlemen to accompany them to a very noted Club. As I entered the room, I was invited to take my seat among a very small, and possibly select, circle. One of my friends, who evidently was also a friend of a certain gentleman present, said: "Do you know that it is my privilege to-morrow, though I am not a member, to be allowed to attend a meeting of the Institution of Gas Engineers, and there listen to the President's Address." Up went the other gentleman's hands, and he said: "Then God help you." That is not a story in one sense of the term; it is true. When the gentleman became aware of my identity, he did not attempt to apologize, because he found it was useless; but I can imagine that his feelings must have been at that stage quite as inexpressible as my own feelings are at the present moment. It has been, as Mr. Carter said, a very busy year; but it has been a most interesting one. What is the use of a man taking upon himself an office of this kind, unless he finds material to his hand by which he can achieve something, and feels, when the end of the year arrives, that he has done something? I will be perfectly candid, and I will confess to you that the writing of my address has been the most irksome duty during the year that I have had to undertake. It was not so much the actual writing of it; but there were so many items demanding attention right through the piece, that one could not sit down and give attention to every one. If it has met with your approval, and presented to you gas matters as they appear to us to-day in anything like a true light, then I have certainly been more than rewarded. I thank you, Mr. Carter, Mr. Bond, ladies, and gentlemen, for your expression of thanks for my humble efforts to place before you a review—shall I say of the gas affairs of the country as they appeal to myself? I hope it has been intelligible; and I hope that no harm has been done.

Report of the Research Committees.

The report of the Refractory Materials Committee was then presented by Mr. F. J. BYWATER (London), who expressed his regret that Mr. J. W. Helps, the Chairman of the Committee, was not present to move its adoption. It was as follows:—

REFRACTORY MATERIALS COMMITTEE.

The Refractory Materials Committee submit herewith their annual report, which includes the third section of the standard specification—viz., that relating to silica bricks, blocks, tiles, &c.—in the preparation of which they have again collaborated with representatives of the Retort and Fire-Brick Section of the Society of British Gas Industries, together with several other large manufacturers of this class of material. Dr. H. G. Colman, D.Sc., has acted as Chairman of the Specification Sub-Committee, and Dr. J. W. Mellor, D.Sc., the Principal of the Staffordshire County Pottery Laboratory, as its Technical Adviser.

This section deals generally with bricks, &c., containing upwards of 80 per cent. silica; and, as will be seen from the specification, material covered by it has been divided into two classes:—

(1) "Silica"—containing 92 per cent. and upwards of silica.

(2) "Siliceous"—containing from 80 to 92 per cent. of silica.

Samples of bricks were obtained from a large number of representative firms for testing by Dr. Mellor; and the results so obtained have served as a basis for the clauses of the specification. Owing to the almost entire absence of authentic tests and results on a working scale of silica and siliceous material, the Committee wish to state that this section of the specification, as with those relating to retort and fire-brick material, must not be regarded as final, and revision, which generally may tend towards a somewhat higher standard, and the inclusion of other tests, will be undertaken from time to time as experience is obtained both by the manufacturers preparing material to conform to the present clauses and also by engineers using it.

With regard to sections 1 and 2 of the specification, the Committee have now also agreed with the representatives of the manufacturers to a slight revision of some of the tests. These alterations are generally of a similar nature to those foreshadowed when the specifications were published.

Sufficient experience has now been obtained with sections 1 and 2 of the specification, which relate to retort and fire-brick material, to enable the Committee to state that very considerable improvement in the quality and uniformity of refractory materials will be obtained, by reason of the tests instituted, both on the part of the purchaser and the manufacturers, a large number of whom have shown themselves willing and anxious to improve their goods and submit them to test. The Committee, therefore, hope that engineers will

adopt the specifications for the purchase of their retort and fire-brick supplies.

A higher initial cost may be involved, but it is confidently anticipated that this will be more than met by the improved results obtained; and if second-grade fire-bricks be judiciously purchased for those parts of retort-settings which are only subject to moderate temperatures, it should be possible to reduce considerably, if not entirely balance, any increase in cost of retorts, &c.

It should be pointed out, however, both in justice to those manufacturers who are prepared to work carefully to the specifications and to the engineer adopting them, as also to the Committee responsible for their preparation, that it is necessary to take care that they are adhered to, and that the material purchased in accordance therewith is subjected to the tests specified. It is only in this way that continued improvement in the quality of retort and fire-brick material is to be expected.

STANDARD SPECIFICATION FOR REFRACTORY MATERIALS.

Section 3.—Silica Bricks, Blocks, Tiles, &c.

The material covered by this specification is divided into two classes:—

(1).—That containing 92 per cent. and upwards of silica, and hereinafter called "silica" material.

(2).—That containing from 80 to 92 per cent. of silica, and hereinafter called "siliceous."

Refractoriness.

Clause 1.—Test pieces of the material shall show no sign of fusion when heated to the following temperatures:—

"Silica" material—not less than Seger cone 32 (about 1710° C.).

"Siliceous" material—not less than Seger cone 29 (about 1650° C.).

The test shall be carried out in an oxidizing atmosphere; the temperature of the furnace being increased at the rate of about 50° C. per five minutes.

Chemical Analysis.

Clause 2.—A complete chemical analysis of the material is to be provided when required by the engineer (or purchaser), for his personal information only.

Surfaces and Texture.

Clause 3.—The material shall be evenly burnt throughout, and the texture regular, with no holes or flaws. All surfaces shall be reasonably true and free from flaws or winding.

Contraction and Expansion.

Clause 4.—A test piece, when heated in a gas-muffle or electric furnace to a temperature of Seger cone 12 for two hours shall not show, on cooling, more than 0·75 per cent. linear contraction or expansion. The temperature of the furnace shall be maintained constant throughout the testing period; and the test-piece shall be at least 4½ inches long by 4½ inches wide—the ends being ground flat, and the contraction or expansion measured by means of Vernier callipers reading to 0·1 mm.—a suitable mark being made on the test-piece, so that the callipers may be placed in the same position before and after firing. The test sample shall not be taken out of the middle of a brick, block, or tile, but shall be representative of the whole.

Variations from Measurements.

Clause 5.—In the case of ordinary bricks, 9 in. by 4½ in. by 3 in. or 2½ in. thick, there shall not be more than ± 1½ per cent. variation in length, nor more than ± 2½ per cent. variation in width or thickness; and in all cases the bricks shall work out their own bond. Special bricks, blocks, or tiles shall not have more than ± 2 per cent. variation from any of the specified dimensions.

Cement Clay.

Clause 6.—This shall be machine ground, and at the discretion of the manufacturer may contain a suitable percentage of fine grog. But in all cases the cement clay shall be quite suitable for the purpose of binding together the bricks, blocks, or tiles, for which it is supplied, and shall be capable of withstanding the same test for refractoriness.

Inspection and Testing.

Clause 7.—The engineer (or purchaser), or his agreed representative, shall have access to the works of the maker at any reasonable time, and shall be at liberty to inspect the manufacture at any stage, and to reject any material which does not conform to the terms of this specification. Pieces representative of the bulk may be selected for the purpose of testing either before or after delivery; but in every case a representative of the maker shall, if he choose, be present when such selection is made, and shall be supplied with a similar piece of the material to that taken for the purpose of testing.

Any complaint as to quality of material to be made by the purchaser before the expiration of ten days after delivery.

If the engineer (or purchaser) and the maker are not prepared to accept each other's tests, they shall agree to submit the samples for testing to an independent authority to be mutually agreed upon; and the engineer (or purchaser) reserves to himself the right, if the material does not conform to the tests laid down in the specification, to reject any or all the material in the consignment from which the test-pieces were taken.

The cost of these independent tests and of any bricks, blocks, or tiles, damaged before delivery for obtaining test-pieces, shall be equally divided between the purchaser and the maker if the test proves satisfactory; and if unsatisfactory, such cost, and that for all other subsequent tests required on this account from the same consignment, shall be borne by the makers.

The cost of any tests or of any material damaged for the purpose of obtaining test-pieces after delivery shall be borne by the purchaser in the event of the test being satisfactory, and if unsatisfactory by the manufacturer, in a similar manner to that specified for the tests prior to delivery.

Appendix and Notes.

Refractoriness.

Clause 1.—For general remarks and suggestions for testing, also table for softening temperatures of Seger cones, *vide* appendices of sections 1 and 2. The cones should in all cases be placed relative to the sample, so that both are subjected to the same temperature.

Contraction or Expansion.

Clause 4.—For general remarks, *vide* appendices of sections 1 and 2. As soon as cone 12 has squatted, it ceases to furnish any further indication of the temperature of the muffle; so that the subsequent temperatures should be ascertained, at about 15-minute intervals, by means of a pyrometer. It is essential, however, that the temperature should be maintained constant; and if it is necessary to remove plugs, &c., for the purpose of obtaining the temperature, great care must be taken to avoid cooling the furnace by such means. As in the test for refractoriness, the cone should be placed in such a position relative to the sample under test, that both may be subjected to the same temperature.

Inspection and Testing.

Clause 7.—It has been pointed out by the representatives of the manufacturers that, owing to the high cost of carriage, they may be involved in serious loss if material is extensively condemned after delivery. They agree that the purchaser must have entire freedom to test, and reject if necessary, any material delivered to him; but it is suggested that, until all the manufacturers have suitable arrangements and appliances for constantly testing their goods, it may be possible to render them some assistance by allowing a fairly large sample of their material to be sent in for testing and general approval before extensive deliveries are made. This is in no way, however, to be construed as removing the right of the purchaser to test material in any subsequent consignment.

REVISION OF THE SECTIONS OF THE STANDARD SPECIFICATION ALREADY ISSUED.

Section 1.—Retort Material.

Contraction or Expansion.

Clause 5.—For "cone 12" substitute "cone 14," and for 1 per cent. variation substitute 1¼ per cent. After the test temperature has been reached, the furnace shall be maintained constant at that temperature throughout the testing period. The size of the test-piece shall be 4½ inches long by 4½ inches wide, and shall be representative of the whole piece of retort or retort-tile from which it is taken.

Other portions of the clause to remain as before.

Inspection and Testing.

Clause 6.—This shall now read as slightly amended in section 3 of the standard specification—viz., test-pieces are to be reasonably representative of the bulk of the material, and no complaint as to quality can be made after the expiration of ten days after delivery.

Section 2.—Fire-Bricks, Blocks, Tiles, &c.

Contraction or Expansion.

Clause 4.—For "cone 12" substitute "cone 14;" and, in the case of No. 1 grade material, for 0·75 per cent. (expansion or contraction) substitute 1 per cent. In No. 2 grade material, for 1 per cent. substitute 1·25 per cent.

After the test temperature has been reached, the furnace shall be maintained constant at that temperature throughout the testing period. The size of the test-piece shall be 4½ inches long by 4½ inches wide, and representative of the whole piece from which it is taken.

The other portions of the clause to remain as before.

Inspection and Testing.

Clause 9.—This clause is amended in the same way as clause 6 in section 1—see above.

Appendices and Notes.

Test for Refractoriness.

Add to existing notes the following: "The cones should in all

cases be placed relative to the sample so that both are subjected to the same temperature."

TESTS FOR CONTRACTION OR EXPANSION.

Add to existing notes that given under this heading in section 3 as to maintenance of temperature of testing-furnace, substituting "cone 14" for "cone 12."

INSPECTION AND TESTING.

Add note in appendix of section 3 above.

Mr. BYWATER having formally moved the adoption of the report,

Dr. H. G. COLMAN said: I have much pleasure in seconding the adoption of the report; and, in doing so, I do not think I need detain you very long. I also much regret that Mr. Helps, the Chairman of the Committee, is not here to move its adoption himself. With regard to the report, I would only say that I think we are moving in the direction of what is the object of the formation of the Committee, and that is the ensuring of the supply to gas undertakings of a suitable material which will withstand all conditions of heat to which it has to be subjected, and, at the same time, to enable the manufacturers to understand what we want. The manner in which the two sides have worked together, as I said at the meeting last year, has been most admirable; and we owe a debt of gratitude to the members of the Society of British Gas Industries for the way in which they have helped us. The great burden of the work in connection with the report has fallen upon Mr. Bywater; and I am sure the Institution is exceedingly indebted to him.

Mr. J. P. LEATHER (Burnley): I hardly know how to start what I am going to say; but I feel rather like criticizing the report. In doing so, I do not wish to minimize too greatly the work of the Committee, for it has been in the right direction. But my point rather is that it is a long way from going far enough. What we want is to so manage matters that the manufacturers will be brought up to a high standard of perfection. When this question was brought before us two or three years ago, we were told, for instance, that the German manufacturers were many miles ahead of the English ones, and that something must be done on this account. I think that, in spite of the work of the Committee, there is even now a great deal of truth in that; and what we want to do is to make the standards put before us high enough to cut out those manufacturers who are not working as they ought to do, and thus gradually raise the standard of work. In the first place, on the question of the temperature which fire-bricks should stand, I do not think we have, in any of the branches of the three sections of the specification (and I presume, seeing that the first two sections are mentioned, we can criticize all three at this time), a temperature high enough for the limit of refractoriness. I say this on one or two grounds. In the first place, it is possible to-day to make a fire-brick that will stand a higher temperature than is put down in this section for a silica brick. This, perhaps, is rather a large assertion to make; but I believe that it is possible, although I do not say at what cost. Methods are being introduced; and, of course, the higher we make our standards in the specification, the more inducement will there be for manufacturers to produce new methods for the purification of fire-clay by which it is possible. I am not prepared to say at what cost; but it is being introduced, without doubt, for some works for things which are called upon to stand a much higher temperature than we employ. Methods are adopted for introducing a fire-clay which, according to English methods of working, would not produce a satisfactory material for making a fire-brick that would stand as high as a No. 35 Seger cone, which is higher than is put in this report for a silica brick. The test that a brick will stand in an electric furnace is two or three cones higher than it will stand in actual work. I think I am quite within the mark in saying this. A test which is only a half-hour test in an electric furnace would, if you put it on to a 24-hours' test in a furnace at the same temperature, go down two cones. So that we want it to be high enough for our requirements. Actual practice is also a more severe test than a laboratory test in an electric furnace, because of such things as the cutting action of draught on the brickwork. Another point, which perhaps does not refer only to the quality of the brick, but is of considerable interest to us, is the fact that in actual practice some local heating very often occurs to a considerably higher temperature than the average of the setting or the temperature really required. No doubt such a question of local heating is partly a matter of the design of the furnace, which is an important thing for us, as engineers, to consider. These different points, however, make it very essential that the standard temperature which the bricks should sustain in the laboratory test should be considerably higher than that which we expect to make it in practice. The other point, on which I feel there is a great lack in the specification, is the question of alteration of size. We are told to subject a brick to a No. 12 or, with the revised clause, a No. 14 Seger cone, and then to pass an alteration of length of 1 or, I think, 1½ per cent. in the case of retort material. It seems to me that this is a very considerable change of size, and one that ought to be eliminated by manufacturers. I think the secret of doing this is the temperature to which the material is subjected in the kiln. There is no reference—I speak subject to correction in case I am wrong, because I have not the sections of specifications Nos. 1 and 2 before me—in any of the reports of the Committee specifying the temperature at which the material is to be kilned. I think this is the really important point—that retort material, whether fire-brick or silica, should be exposed to a higher temperature in the kiln than it is required to sustain in practice. This has a theoretical explanation, and it is that, if you take the case of silica brick, silica has various forms. As the temperature is increased, it changes from a crystalline to an amorphous condition; and if it is not subjected to a sufficiently high temperature in the process of manufacture, this change takes place afterwards in our settings. I quite accidentally got into conversation this morning with a gentleman, whom I had not met before, who told me that in certain steel-works it is the practice, before using bricks which they have purchased from the best manufacturers, to submit them to a higher temperature in their own furnaces; that is, to put into their furnace the number of bricks which the furnace can accommodate, and take them out again just in order to give them the extra baking, and so as to secure that the expansion or contraction should have reached its full amount before they used the bricks for building operations. I believe it is not a published fact, but I was assured that this actually takes place. I think the Committee would do well to investigate the matter of the alteration of length in relation to the temperature to which the material is subjected in manufacture. I think, if this is done, they will find that it is feasible to put into a specification a very much stricter clause with regard to alterations in length. If we only take the case of a silica brick with this third section as the principal subject, if there is an expansion of 1 per cent. after it is brought into use in our settings, consider what it means in a setting 20 feet through—say in expansion—and what the effect is upon the structure of ironwork binding the setting together in connection with the foul mains. The relation of the setting to overhead coal-hoppers, and so on, will not amount to a great deal—say only a foot in a bed 100 feet long; but this would be an enormous expansion, and one that would be disastrous in many cases. On the other hand, if there is a contraction, as in the case of ordinary fire-brick, what may it mean in the opening-out of regenerators and the bye-passing of gas? I think on both these two points the specification requires very considerable emendation before it can be considered as being entirely satisfactory.

The PRESIDENT mentioned that Mr. Perry, the Chairman of the Fire-Clay Goods Section of the Society of British Gas Industries, was present, and that he had taken great interest in the report before the meeting.

Mr. G. H. P. PERRY said that, as a body of manufacturers, they had had an opportunity of conferring with the Committee on Refractory Materials, and, although there had been some give-and-take in certain of the details, they had endeavoured in every way to fall in with the present specification. They were much indebted to Mr. Bywater for his help and assistance in the matter. He (Mr. Perry) could only say that they were always open to receive help and assistance; and, as a manufacturer, he should like to add that on the present specification he and his colleagues were quite prepared to work with the Committee.

Dr. R. LESSING (London): If I may be allowed, I should like to answer some of the points raised by Mr. Leather. I have frequently criticized the matter during the meetings of the Joint Committee, and I may say that all his points were very minutely considered. Not only so, but reports have been laid before the members of the Committee that bore exactly on the questions Mr. Leather has raised. The subject of contraction alone gave rise to a discussion lasting from eleven in the morning till six in the evening at the last

Committee meeting. I think the members will agree that the labours of the Committee, which are expressed in the report, were not altogether of a rash character, and that they have stood the trial of the criticism from various experts—the manufacturer, the user, and the outside expert. In all the criticisms that can be brought forward on the specification, it has to be borne in mind that, after all, the material that is available must be used. It is all very well to specify terms of contraction less than 1 per cent.; but it would be utterly impossible to obtain material in adequate quantities and of sufficient cheapness to be of use in gas-works at all. I agree with Mr. Leather that it is quite possible to make material that will stand a fire-brick specification; but, after all, it is quite open to manufacturers to supply such material to those who like to have it and are prepared to pay for it. The specification is meant for the bulk of users, and not for those who must have special materials. It is intended for the bulk of the users who cannot possibly go to the limit of any specification. You have to use some amount of common sense; and it is well understood that all the figures given in the specification are only the minimum limitation. Of course, any engineer is at liberty to ask the manufacturers to supply, and I think all the first-class manufacturers in the country are prepared to supply and are actually supplying, material going beyond the terms of the specification. But no manufacturer will be in a position to guarantee this. The guarantee must always be a safeguard; and he must not expose himself to any danger of being challenged if he does not, in the circumstances, come up to the guarantee. As the specification stands, I think it is quite sufficient to meet all the requirements of engineers at the present moment. It is only a tentative arrangement. During the short time of the existence of the two Committees, a very great advance has been made; and I have no doubt the specification will be a means of further advance, to the mutual interest of both parties.

Mr. W. B. Randall (Waltham Cross): I rise to criticize the specification, not in any way in a hostile spirit, but in an endeavour to obtain some knowledge on a subject which has been a source of very great trouble to me during the last twelve months. We have been raising our carbonizing temperatures in order to produce a greater quantity of gas per ton of coal, and have obtained over 14,000 cubic feet without the aid of carburetted water-gas appliances. We want to go farther than this, and get 15,000 or 16,000 cubic feet; and I believe we shall get it if the fire-clay material people will really help us. I do not want to say anything unkind about them, but my experience in this respect has really been disastrous. We have found that the materials will not stand the tests given by the Refractory Materials Committee in their schedule; in fact, they are very much below it. They are great sinners indeed. I interviewed the representative of one of the best firms—a well-known one—at Stourbridge. He saw our settings, and he saw our temperatures. He retaliated by saying: "Look at the price the London Companies pay. Look how they cut us down." He said: "Give us another 1s. a foot, and you shall have something worth having." I said: "Very well; send the best material you can." He did so. What was the result? When it came, it immediately melted away; and I found it comes out at an absolutely lower melting-point than the old material. With regard to this question of the report, I cannot understand why the Committee should say: "The test shall be carried out in an oxidizing atmosphere." I cannot go into the question of fire-clay materials as an expert, but I speak from the retort-house point of view, and that is really the test of everything. The retort-house point of view of a regenerative furnace is that we have a reducing atmosphere, and not an oxidizing atmosphere at all. That is really a very important point, because I understand from one of the experts that if you have iron oxide at just over 1000° C. it will be 500° lower than in an oxidizing atmosphere. This is an important point, because if we are working from this specification we might have the settings in, and they would melt at a low temperature; and then the manufacturers would immediately turn round to us and say: "You are working in a reducing and not in an oxidizing temperature." There is another point I should like to call attention to. I see it is specified in clause 7 that any complaint as to quality of material should be made by the purchaser before the expiration of ten days after delivery. What does this do? It puts us absolutely out of court, with the sole exception, perhaps, of half-a-dozen companies in England who have the benefit of having testing furnaces by which they can immediately test the material as it comes on to the works. I have told you what we tried to do. We sent to one of the best experts in February last, and we are still waiting for his report. You must allow a longer period than that which is here given for the testing. In conclusion, I would say that I hope the remarks I have made will not be taken to be in any hostile spirit, because I am simply asking for suggestions as to where we can obtain, without having to go to the Continent for it (because I understand we can get it there), suitable material that will stand a fair temperature—not an extraordinary temperature at all. I have not gone into the details, but our temperature in the combustion chamber is 2400° and in the retort somewhere about 2000°. These figures may be taken as reliable, as they were made by the Cambridge Scientific Instrument Company. The fact is we get the fire material—slag—running down just like glass; and we have made nostrils in our combustion chamber in order that we can rake out the glass.

Mr. T. Canning (Newport, Mon.): I do not wish to make complaints, and I am quite sympathetic with the work that has been carried out by the Committee. I think this will be enough to say on that point. But retorts have come under my notice recently—and I will go no further than retorts to-day, because, of course, the experience is a little too short yet to criticize much—which it appeared to me were worse baked than any that I have ever seen before; and they were required for high heats. I also found that they were very liable to fracture. On examining a section of these retorts, I ascertained the material to be a coarse aggregate rather than a homogeneous, cohesive mass such as I think the substance ought to be. These retorts were made by two first-class Stourbridge firms, and they assured me that they had been made in strict accordance with the standard specification. If they were, I can only say that the standard requires emendation in the direction pointed out by Mr. Leather—that is, on the question of baking the retorts. They must be made to stand high temperatures; and if the way in which the materials are prepared does not permit of their being properly baked, then I think considerable revision of the specification will have to be made. I hope the Committee will not misunderstand me. I am entirely sympathetic with their work.

Mr. Bywater: I should like to reply more or less *en bloc* to the whole of the questions that have been raised. My friend Dr. Lessing has informed you already that the question of contraction has been very carefully gone into. I would add that the cone put down for testing retort material is No. 14. That temperature is 2570° for retort material. We found, when we made the investigation of the temperatures which were being employed in retort-settings—and we did not go on any hypotheses—that there are practically no retorts working at 2000°; so that we are testing the retort material at 500° higher than the retorts are being worked at. Therefore, you must agree that a margin of 25 per cent. above the working temperature is a good average, fair working test. I quite agree with the importance of high burning; but we do not intend to go to a manufacturer's works and tell him what he is to do. He knows his own business, or he should do. We test the finished product, and it is his affair. It would ill-become us if we went on to his works. Let him have freedom, and then let us test his work. This question of contraction has been a bone of contention for some time. We have not got all we want; but we do think something should be done to protect the manufacturer. With regard to porosity, I should like to say that I entirely disagree with the last speaker. Retorts ought not to be homogeneous. If they are to withstand the changes of temperature to which they are subjected in working, they should be porous. They should allow of a variation of temperature; and if they are dense, as one speaker suggested, they will crack. I would remind you that in this report we find that the minimum temperature at which retorts will work is 700° Fahr. immediately after they are charged. If you put coal into a retort that is dense, it will immediately crack. I can only say, with regard to this material, that I would suggest that it should be tested in accordance with these clauses, and not accepted without testing. You must absolutely see that you are getting the material you buy. Without saying any more, I do ask you to have the material tested when the manufacturer says he has been working to the specification, though, of course, I do not doubt his *bonâ fides*. With regard to the remarks of Mr. Randall, I would only suggest to him that he should buy his materials on the specification.

Mr. RANDALL: I have done so, and the result I have given you. That is exactly why I have spoken to-day.

Mr. BYWATER: If you are out to get 16,000 cubic feet of gas per ton, I am afraid the specification will not help you. I do not know all the circumstances of the case, but I do think, after all, that 16,000 cubic feet per ton is a rather high standard. We should be glad to see you in two years' time, when the manufacturers have made arrangements so that they can meet you. I can only repeat what I have already said—that if you buy the materials on the specification, and if you are not working at higher temperatures than those you have shown to me, then your setting is at fault. It is not altogether the material that you have to take into account; everybody knows that. The point Mr. Leather raised as to intense local heating comes in. If you are working at a temperature of 2400° in your combustion chamber, I can only say that I have had material exactly the same as you use, and have worked it at 2700°, and it has stood for seven years. You must not blame the manufacturer too much. All the factors ought to be taken into consideration, and a thorough investigation made before you can lay the blame upon the material.

Mr. RANDALL: My point is that I sent a sample of this to the National Physical Laboratory, and I sent them a copy of the specification. The report on the material comes back to me that it is absolutely at a lower fusing-point than the old material, and for it we pay so much per foot extra. In my attempt to get better material, and pay more for it, I have only got worse.

The PRESIDENT: I think we all appreciate Mr. Randall's point, and we all look forward to a greater gas yield when he finds a suitable material. I believe you quite understand the position of the Refractory Materials Committee. They are working by stages; and this is the third stage. You have already seen reports on the previous stages. There may be experiences to be gained both on the manufacturers' side and on ours. All that we ask you to do is to adopt the report as representing this particular stage with regard to the materials dealt with. Like all other standard specifications, it is not compulsory. You may adopt it or not as you like.

The motion for the adoption of the report was then put, and carried unanimously.

Education and Certification of Gas-Fitters.

This subject was introduced by the presentation of the following report:—

REPORT ON THE EDUCATION AND CERTIFICATION OF GAS-FITTERS.

Presented by the Special Committee of the Manchester District Institution of Gas Engineers.

The Special Committee appointed to deal with this question, presented a report to a general meeting of members at Doncaster on the 27th May, 1911, the principle of which was approved. The report was afterwards presented to a meeting of the Joint Commercial Sections in Glasgow in June, 1911, at the time of the annual meeting of the Institution of Gas Engineers, for the purpose of obtaining the views of gas engineers generally; and after a full discussion, a resolution was adopted referring the matter back to the Manchester District Institution of Gas Engineers, for reconsideration in conjunction with the committees of the various District Associations.

The first meeting of delegates from the District Gas and other Associations interested was held at Leeds on the 28th July, 1911, and was attended by: Mr. R. G. Shadbolt, President of the Institution of Gas Engineers (in the chair), Mr. R. H. Smith, Sheffield (Ironmongers Federated Association), Mr. J. Thacker and Mr. T. Phillips, Birmingham (Birmingham Master Gas-Fitters Association), Mr. A. B. Dyson, Halifax (Institute of Plumbers), Mr. T. A. Armitage and Mr. J. Beale, Huddersfield (Institute of Plumbers and Advisory Committee on Plumbing), Mr. J. H. Edmiston, London, Mr. P. Atkinson, Leeds, and Mr. H. Milnes, Leeds (Operative Plumbers Association), Mr. W. D. Helps, Leeds, and Mr. J. W. Wilson, Leeds (Society of British Gas Industries), Mr. J. Paterson, Cheltenham, and Mr. H. C. Head, Winchester (Southern District Association), Mr. T. Hardie and Mr. J. Lewis, Newcastle, and Mr. H. Lees, Hexham (North of England Association), Mr. J. H. Troughton, Newmarket, and Mr. J. H. Brearley, Longwood (Eastern Counties Association), Mr. R. Watson, Doncaster, Mr. S. Glover, St. Helens, Mr. E. H. Hudson, Normanton, Mr. A. E. Mottram, Ossett, and Mr. H. Kendrick, Stretford (Manchester District Institution), Honorary Secretary, Mr. George Helps, Nuneaton.

The Midland, Wales, Scottish, and Irish Associations, although invited, were not represented. Letters of apology were read from the Worshipful Company of Plumbers; Mr. Alex. Wilson, Glasgow; Mr. R. M. Iddon, Southport (Ironmongers Federated Association); Mr. J. F. Bell, Derby, Mr. S. Y. Shoubridge, Sydenham, and Mr. F. W. Goodenough, London (Institution of Gas Engineers).

A very long discussion, in which most of the delegates present took part, followed, and finally it was resolved that: "The first clause of the report advising the formation of classes in gas-fitting, and the use of gas appliances in connection with Technical Schools be adopted, and a Committee consisting of the Manchester District Institution of Gas Engineers Sub-Committee, who drew up the original scheme, and one member of each of the Associations present at the meeting, be appointed to draw up fresh proposals as to scheme and syllabus for submission to a further meeting of delegates.

The new Committee met at the Midland Hotel, Manchester, on the 20th October, 1911, and drafted the scheme, a copy of which is appended, dated 16th November, 1911, and appointed a Sub-Committee consisting of Messrs. H. Lees, Hexham, J. Paterson, Cheltenham, G. Helps, Nuneaton, J. H. Brearley, Longwood, E. H. Hudson, Normanton, and H. Kendrick, Stretford, to draw up a syllabus on lines approved during the discussion.

On October 28, 1911, the unexpected resignation of the indefatigable Secretary, Mr. H. Kendrick, on account of ill-health, was placed in the hands of your Committee, and Mr. E. H. Hudson, of Normanton, consented to take up his duties.

The Sub-Committee, after much consideration, have unanimously approved of the appended syllabus, dated 1st January, 1912, as a model, to be amplified and curtailed as each lecturer and local committee see fit and necessary.

It will be seen that the report with syllabus now presented by your Committee varies considerably from the original one.

The scheme is under the consideration of all the Associations concerned and your Committee ask for your approval in order to act in line with the District Gas and other Associations interested in bringing the same before the Institution of Gas Engineers.

Signed on behalf of the Committee,
R. WATSON, President.
E. H. HUDSON, Hon. Secretary.

Gas-Works, Normanton, Feb. 9, 1912.

APPENDIX I.

FURTHER REPORT OF SPECIAL COMMITTEE ON SCHEME FOR THE EDUCATION AND CERTIFICATION OF GAS-FITTERS.

1. The Committee recommend it is advisable that classes in gas-fitting and the use of gas appliances should be formed in connection with all Technical Schools, and where Technical Schools are not available, that a limited number of small towns should be grouped together and classes promoted at a fixed centre (on a gas-works if no other place is available).

2. That a syllabus be adopted and taken concurrently with a course of practical gas-fitting (comprising pipe jointing in lead and compo, iron barrel work, brass work, attending to incandescent burners, stoves, &c.); to be conducted by a practical gas-fitter.

3. Gas-fitters to be required before receiving a certificate to attend regularly a course of gas-fitting, and the uses of gas appliances to the satisfaction of their instructors, who will certify to that effect.

4. Full certificates to be issued by the authority of the Local Committee to working gas-fitters over the age of 21 years, on presentation of the certificate of attendance from the instructors and proof of the due completion of their apprenticeship.

5. The City and Guilds of London Institute be asked to include the subject in their syllabus as a supplementary course for gas-fitters.

6. The whole course to be under the superintendence of a Local Committee which would recommend instructors to the Technical Schools. The Local Committees to consist of representatives of gas undertakings and trades associations, if any, employing gas-fitters within the same area.

7. The question of raising the necessary funds for carrying on the work, to be left with the Committee of each district.

8. The scheme having been reconsidered by this Committee, shall be submitted if necessary to a full meeting of representatives of the District Gas Associations and Trade Associations, after which it will be referred to the Institution of Gas Engineers, before the various authorities are approached.

Signed on behalf of the Committee,
ROBERT WATSON, *President.*
E. H. HUDSON, *Normanton,*
Nov. 16, 1911. *Hon. Secretary.*

APPENDIX II.

GAS-FITTING AND USE OF GAS APPLIANCES.

DRAFT SYLLABUS FOR TECHNICAL SCHOOL COURSE.

Introductory.—The composition of gas; law relating to gas supply appliances and meters.

Meters.—General construction of wet and dry gas-meters; fixing and reading.

Tools Used in Gas-Fitting.

Pipes and Fittings.—The composition and uses of iron, lead, tin, copper, and brass piping and pipe fittings; blown, screwed, and

flanged joints; pipe laying; testing of pipes and fittings for soundness; apparatus to be used; the effect of pressure of gas and of length and cross section of pipes on delivering capacity, having special regard to the number of burners supplied; description of fittings to be used; consumers complaints and their remedies.

Gas-Burners.—Description of flat-flame burners, regulators, governors, adjustable burners, incandescent with fixed and moveable regulating nipples, bunsen tubes, mixing chambers, air regulators, and the effect of proper regulation on the illuminating power; the distinction between various designs of shades and chimneys; effect of areas of opening on illuminating power; reflection, refraction, diffusion and concentration of light by shades and globes; effect of decoration in rooms on reflection of light; use of chimneys with incandescent burners.

Mantles.—Materials used in making of incandescent mantles, methods of manufacture, collodionized and soft mantles and their relative advantages; effect of different forms of manufacture on their durability.

Inside and Outside Shop Lighting.—The construction of the various types of lanterns for upright and inverted burners; types of burners; ventilation of closed-in windows; advertising signs.

Distance Lighting.—Description of Pneumatic, Telephos, Norwich, Sugg's, and Tuchmann systems; fixing precautions, faults and their remedies.

Gas Cookers.—Gas cookers, grillers, hot plates, boiling burners; ventilation of all kinds of cookers; flue pipes and fixing; influence on down-draught by cowls and hoods.

Gas-Fires and Other Heating Appliances.—Gas-fires, radiators (air and steam), convection and syphon stoves, geysers, circulators, hot-water systems; greenhouse, motor-shed, and workshop water boilers and circulators; effect of radiant and convected heat on air and contents of room when heated by gas.

Apparatus Used for Industrial Purposes.

Gas-Engines.—Motive power; construction of; gas consumption per B.H.P. and I.H.P.; fixing of engines; locating faults; anti-pulsators and their use.

High-Pressure Gas.—Principles upon which increased efficiency is obtained; compressors and blowers; lamps and fittings; advantages for trade purposes.

Ventilation.—Methods of ventilating by gas; diffusion of gases and comparisons of air composition of occupied rooms lighted by gas or other illuminants.

Jan. 1, 1912.

Mr. E. H. Hudson (Normanton): I do not propose to read the report through, but I will try to touch upon some of the points in it. As you know, at the Glasgow meeting of the Commercial Sections, a report was presented from the Manchester District Institution respecting the education of gas-fitters. The report was relegated to a Committee, to be composed of the Manchester District Institution Committee and the members of the other District Associations. The result was that a meeting was held on July 28, 1911, which was attended by representatives of the District Associations and also the Trade Associations. There were members present from the various Associations which you will see set out in the report. At the meeting, the scheme presented to the Glasgow meeting was thoroughly thrashed out; and I think almost every delegate who attended had something to say about it. The outcome was that the scheme was adopted in principle; but as to the details, it was relegated to a further Sub-Committee consisting of members of each Association. The Sub-Committee met in Manchester, and adopted the scheme which is presented in Appendix I. They found that their greatest difficulty was in the framing of a syllabus on which the instruction of gas-fitters should be based. They, therefore, placed this special matter in the hands of a Committee consisting of various gentlemen, who exchanged notes on the subject, and eventually came to the unanimous decision that the syllabus here presented was one on which to form a basis to educate gas-fitters. Later on in the proceedings, we shall have a paper from Mr. Brearley. On reading through it, I find that he touches materially on this scheme as it affects the present gas-supply companies. I can only say that the Committee who drafted the syllabus have tried to bring in some scheme whereby gas-fitters who are not really qualified to take the "Supply" course should receive instruction, and be able to perform their duties in a satisfactory manner. It must be apparent to you that some such scheme is necessary. We have all had experience of the bad work done in connection with the fitting-up of gas apparatus. It is with this view that the report is now presented, so that we may go forward from the Institution of Gas Engineers to the City and Guilds of London Institute to induce them to attach to their technical classes one which will educate the ordinary gas-fitter. I should not like the debate on Mr. Brearley's paper to at all interfere with this scheme, nor yet that the discussion on the scheme should detract from that which ought to take place on Mr. Brearley's paper. But, whatever is the outcome of the discussion on the paper, it would afford a means to guide the Committee in approaching the City and Guilds of London Institute in order that the two classes should not overlap. We should, as a preliminary, teach the gas-fitter, and then, if he desires to take the "Supply" course later, in order to become more efficient in the other matters relating to the distribution of gas, he can do so. I have great pleasure in proposing that the members of the Institution adopt this report, so that the Council can proceed to put it into effect.

Mr. Thomas Glover (Norwich): I have great pleasure in seconding the proposal which Mr. Hudson, the Secretary of this department of our work, has made. We desire now to secure the support of the Institution in taking the next step, which will be to secure the influence and help of the City and Guilds of London Institute. The work which is being done in training and examining in different branches of our work may be extended to, and include, the special branch of examining the men whom we have taught to meet our consumers and do the work on their premises. I hope the proposal will receive your hearty support; and if there are any questions to be asked with regard to it, now is the time. If, after the meeting is over, anybody desires information, Mr. Hudson will be only too glad to supply it.

The President: Before any discussion takes place on the report, I may just emphasize the words that have fallen from Mr. Hudson with regard to the discussion. This report has been considered and adopted by the Couucil, and if you follow the course proposed, of adopting it, it will then remain for the Council to take whatever course may be necessary to present it to the City and Guilds of London Institute and confer with them. As you know, Mr. Brearley, in his paper, raises certain points; and if anyone wishes to deal with these or similar points, I will ask him to reserve his remarks till the paper has been read. The discussion on the paper will be more in the nature of a guide to the Council taking further proceedings, so that if you enter into the details now, it would merely be unnecessarily taking up time on the report. May I ask you to bear this in mind in any remarks you may make on the report?

Mr. W. Cranfield (Halifax): I thank you, Mr. President, for your courtesy in allowing a voice from a perhaps unusual quarter to be heard in this meeting. I wish to speak on behalf of the Junior Gas Associations. When this scheme has been under consideration, the net has been cast very broadly and widely, and all kinds of Associations, all kinds of helpers, have been called in, with the one exception of the section of the gas industry that is particularly concerned with educational matters. When this matter was brought up a few weeks ago at the Joint Council meeting of the English Junior Gas Associations, a number of ways were pointed out to me in which we might have made our voice heard, in which we might have made claims for representation, and such like; but, on the whole, I think it was well that it was not done. The Junior Gas Associations do not consist of a number of young men in a hurry. I do not know that they have shown themselves particularly insistent upon claiming rights. Their voice has not been particularly clamant; and I think I may say that they have rather waited to be asked than pushed themselves forward. I think, perhaps, speaking with all modesty, I have seen as much of the inside working of the Junior Associations as anyone.

Mr. S. Glover (St. Helens): I rise to a point of order. Are we discussing the relations between the Junior and the Senior Associations?

The President: Perhaps I might explain that Mr. Cranfield's point is that the Junior Associations should have had a voice in the matter. His object is to bring this before the meeting; and he is quite in order.

Mr. Cranfield: I will not say anything more on the point except that our work is purely educative, and we just adopt the Prince of Wales's motto: "We serve." I am only speaking with an anxiety to assist in service. I am not claiming any rights or dealing with any relationship between the two Associations. But I think it would not have been without benefit to the discussion of this scheme if those who are particularly in touch with the young men might have put their views forward. There is always a danger in educational matters of planning from the top downwards. It is sometimes the weakness of certain of the Universities. Perhaps it has been not altogether without its influence in the Gas Section of the Leeds University. The courses there

have been planned from the top, with perhaps too little consideration for what is exactly needed. There is too great a tendency to draw up a scheme and say "This is the proper thing;" whereas a little inquiry from below might not have been without advantage. One of the maxims in political life is government by the consent of the governed; and we might transfer this a little, and talk of education, not exactly with the consent of the educated, but from the standpoint of the educated. I am rather concerned in the drawing-up of this scheme, which I have studied closely and fully, as to whether it sufficiently realizes some of the modern tendencies in education. Coming up to this meeting, I read most of the papers which were being submitted at a conference at the Caxton Hall; and I was struck with the breath of fresh life in all educational matters. Knowing pretty widely, as I do, the modern tendency in technical and other instruction, I am afraid lest the new breath of life in educational matters should not be even slower in getting to technical subjects than in getting to University matters. I am only speaking personally on this point, but I am anxious that in this particular scheme we should not make too great haste. You have heard the danger of its overlapping the "Supply" course of the City and Guilds of London Institute. If we commit ourselves too soon to handing this over as a cut-and-dried scheme to the Institute, I am afraid it will have pretty well passed beyond our reach. I would personally suggest that the scheme should be worked for a year somewhat quietly and tentatively. I have more to say about the scheme; but I think I had better postpone it till the discussion on Mr. Brearley's paper. Good as it is—and it is good—and evident as it is that there has been much good work spent upon it, still it is not necessarily perfect yet; and I think we shall gain a good deal of experience with a little quiet working of it first.

The PRESIDENT: I have taken the responsibility of asking Mr. Cranfield to appear here to-day to give us the benefit of his views on this point, because I know he is so intensely interested in this and other educational schemes, and he has been to great trouble to study the requirements from the point of view of students of all kinds—gas-fitters and the rest. Many of our young and budding engineers of to-day have to thank Mr. Cranfield for a good deal of their technical education. With respect to the juniors, perhaps I may at this stage read a letter I have received from the Joint Council of the English Junior Gas Associations, which will possibly put the case a little more emphatically than Mr. Cranfield has done; his remarks having been suggestive only. He has not made a definite suggestion to us, and this letter will possibly assist us a little.

> Dear Sir,—The Joint Council of the English Junior Gas Associations hold an annual meeting to consider matters of common interest to the junior members of the gas profession.
>
> There has been a desire for some years now to bring before the Council of the Gas Institution the existence of such a Joint Council, in order that the Council of the Institution (if they so desired) could obtain an expression of opinion on matters affecting gas-works assistants, whenever these came up for consideration.
>
> The Joint Council think that the scheme for the training and examination of gas-fitters is one of those questions that mainly affect the very members the Junior Gas Associations are endeavouring to help; and they have therefore requested me to write to the Council of the Gas Institution suggesting that—
>
> > "In the carrying out of the scheme for the training and examination of gas-fitters, the Local District Junior Gas Associations be invited to appoint a representative to serve on the Local Administrative Committees."
>
> The Joint Council know from past experience your interest in the Junior Gas Association movement; and they would deem it an honour to receive your support when this question is brought forward.
>
> Of course, should the Council desire the Juniors to appoint a representative to express their views more fully, the matter would receive prompt attention.
>
> On behalf of the Joint Council, allow me to thank you in anticipation, and remain,—Yours faithfully,
>
> (Signed) ALFRED L. HOLTON.

There you have in a nutshell the position of the Junior Gas Associations. It is quite a legitimate one; and it evinces a strong desire to be of service. It is all based upon the question of the formation of Local Committees. Might I suggest, as these Local Committees have yet to be formed, that as our next step we should present the matter to the City and Guilds of London Institute? It is only after they have accepted it that we can proceed with the formation of Local Committees. After the representations that have now been made by the Junior Associations, there is little doubt that, in the districts where the assistant engineer and the manager are likely to be of service on the Local Committees, they will be made the greatest possible use of. There may be other districts where there is not a single junior. But whether or not they be members of the Junior Associations, there may be districts where there is not one man who is suitable for the purpose or is available; and in cases like this, one can imagine that it would be very difficult if we bound ourselves to bring in junior members from every district. We might have to import men from other districts. These are all matters of detail which can be left at the present time. Do you approve of the Council going forward with the matter, or do you not? That is the resolution proposed. If any gentleman wishes to move an amendment, or to add any further remarks on the report itself, now is his opportunity.

Mr. H. C. HEAD (Winchester): From Mr. Cranfield's remarks, I rather gather that he considers the scheme before us to be one for the education of gas engineers. I was upon the Committee, and I understood it to be nothing of the sort. The members of the Committee were very anxious that this scheme for the education of gas-fitters should not have anything to do with the examinations in "Gas Supply," which are for those who are going to be distributing engineers. This scheme is purely and simply one for the better education of working gas-fitters; and you will notice that in the report the word "examination" is carefully omitted. The members of the Committee felt—some of them very strongly indeed—that it would be a great mistake if, on a written examination, a certificate were issued to a gas-fitter with which he could go about the country saying: "I have passed an examination in gas-fitting; I am a gas-fitter." You will notice that the report carefully says that certificates are to be issued to gas-fitters who have satisfied their instructors, not to those who have satisfied their examiners. If a man has attended his instruction, taken an intelligent interest in it, and shown intelligent appreciation of what has been imparted to him, he is to have a certificate that he has benefited by his instruction, but not that he has passed an examination, and has qualified to a certain extent as an engineer. I hope I have made my point clear—that we want to differentiate clearly that this is only the training and not the examination of gas-fitters.

The PRESIDENT: I think we agreed to that. What you have said makes it very clear.

Mr. GLOVER: Would you promise, Sir, that the letter you have read should go to the Secretary of the Section, and that any further suggestions you may receive should have due consideration?

The PRESIDENT: That is for the Institution to deal with. They are in possession of the letter, and this will be one of the things that will guide the Institution in referring matters back to the various districts.

Mr. W. W. TOWNSEND (Hereford): I rise to move that, in the further consideration of this question, the Council of the Junior Gas Associations should be asked to nominate some member who would assist the Committee with his advice, and put forward his opinions, on the scheme for the education of gas-fitters. It is clear that this scheme is not intended for the junior gas engineers, but for gas-fitters; and they are represented on the Junior Associations. I think it would only be fair to give them an opportunity of criticizing the scheme before it is worked out. I think it would be a graceful act on the part of the Institution to ask the Junior Associations each of them to nominate one member on the Committee.

The PRESIDENT: If we adopt your suggestion now, we shall delay the matter for twelve months pending the criticisms and suggestions of the Junior Associations. I do not think they themselves would favour such a step as that. Do you or do you not adopt this report, which has been submitted for your adoption by the Council, so that they may proceed? When it comes to the publication of the scheme, I may safely pledge the Council to see that the Junior Gas Associations have every possible consideration, and their services made the most use of.

The motion for the adoption of the report was carried unanimously.

Reading of Communications.

The reading of papers was then proceeded with. They were taken in the following order:—

Wednesday.—"The Incidence of the Day Load," by Mr. H. Townsend, of Wakefield. "High-Pressure Gas for Manufacturing Purposes," by Mr. A. W. Onslow, of London. "The Evolution of the Stockport Gas-Works," by Mr. S. Meunier, of Stockport.

Thursday.—"A Laboratory Method for the Comparison of the Coking Properties of Coals," by Dr. R. Lessing, of London. "Some Observations on the Examinations in Gas Engineering," by Mr. Thomas Glover, of Norwich. "The State of Knowledge of Distribution Employees, as Displayed in the Answers to Four Years' Examination Papers," by Mr. J. H. Brearley, of Longwood.

The papers, with reports of the discussions upon them, will be found in later parts of the "Journal."

THE BENEVOLENT FUND.

On Wednesday morning, the annual meeting of the donors and subscribers to this fund was held. A report of the proceedings will be found on p. 836.

The New Officers.

The President announced the result of the election of office-bearers for the current year as follows:—

President.—Mr. Corbet Woodall, of London.

Vice-President.—Mr. John Bond, of Southport. [Mr. Edward Allen, of Liverpool, is the Senior Vice-President.]

New Ordinary Members of Council.—Mr. Thomas Berridge, of Leamington; Mr. J. H. Brearley, of Longwood; Mr. C. Dru Drury, of Sunderland; and Mr. S. Glover, of St. Helens.

Auditors.—Mr. J. L. Chapman and Mr. E. W. Drew.

Hon. Secretary.—Mr. S. Y. Shoubridge.

New Members Elected.

The following candidates for membership of the Institution were elected:—

Members.

Armitage, Charles, Engineer, Corporation Gas-Works, Lancaster.
Carr, William Moncrieff, Engineer and Manager, Ormskirk Gas Company.
Duxbury, William Thomas, Gas and Water Manager, Atherton Urban District Council.
Elliott, Francis, Manager and Secretary, Leyland Gas Company.
Fisher, Joseph, Assistant Engineer and Manager, Tottenham and Edmonton Gas Company.
Lane, William Thomas, Assistant Engineer and Manager, Bombay Gas Company.
Outon, Charles Brook, Gas Engineer, Great Southern and Western Railway, Ireland.
Sandeman, William James, Distribution Superintendent, Croydon Gas Company.
Snelgrove, Leofric Marshall, Engineer and General Manager Oriental Gas Company.
Williams, Archibald Edgar, Assistant-Manager, Poplar works of the Commercial Gas Company.

Associate Members.

Allan, Andrew Philip, Assistant Manager and Secretary, Scarborough Gas Company.
Belton, Charles M. D., Assistant Engineer and Secretary, Shrewsbury Gaslight Company.
Clark, Joseph George, Technical Assistant to the Gas Sales Department, Gaslight and Coke Company.
Parker, Walter, Superintendent, Gas Street Gas-Works, Bolton.
Rogerson, William, Manager, Gas-Works, Bollington.
Willis, John Hector, Draughtsman, Smethwick Corporation Gas-Works.
Winslow, David John, General Assistant, Lea Bridge District Gas Company.
Young, John, jun., Assistant Manager, Gas-Works, Leighton Buzzard.

Honorary Members.

The President moved the election as Honorary Members of the President of the Société Technique de l'Industrie du Gaz en France, the President of the German Association of Gas and Water Engineers, and Professor W. A. Bone.

Mr. Samuel Glover (St. Helens) seconded the motion, and it was carried unanimously.

Votes of Thanks.

Mr. Corbet Woodall, in returning thanks for his election as President, said he was not quite sure as to the wisdom of choosing one of the oldest members of the body. Personally, he did not complain of it; but he did not know whether it was quite fair to the Institution. As far as lay in his power, he was prepared to maintain the reputation of their annual meetings, and to carry on the work which had been particularly characterized by their friend Mr. Shadbolt—namely, the association of the Institution with matters outside the mere questions of engineering and management, the making of the Institution what he might call the Parliament of the Gas Industry. They were taking up a position with regard to their great industry which no other body was able to do.

The Jubilee Exhibition.

The President reminded the members that next year would be the occasion of the holding of the Jubilee Festival of the Institution, in connection with which there would be an exhibition at Shepherd's Bush. It would be remembered that a circular had been issued asking the gas undertakings to guarantee a fund of possibly £10,000; it being considered that this sum would be necessary in order to ensure the success of the scheme. In addition to the exhibition itself, and all that would accrue therefrom, the subscribing undertakings would be provided with a number of tickets relatively to the amount of their subscription. A very little time had elapsed since the appeal had been made; but they had received 79 replies from undertakings, 45 of whom had guaranteed no less than £4000. He thought this showed that the thing would go forward with success. The great bulk of the undertakings promising support were provincial. This was an instance of the new spirit which was moving among the gas undertakings of the country. If a similar appeal had been made two years ago, they might not have had a single response. Some people had the idea that possibly in October the place selected for the exhibition would be rather a desolate one; but he could assure them that there would be plenty to interest them all.

Mr. Corbet Woodall said he had taken an opportunity, in company with the Chairman of the South Metropolitan Gas Company, to visit the site of the proposed exhibition, and he was satisfied that better premises could not be found for the purpose. They were very fine halls indeed, and the proprietors would put them into proper repair. There was space enough for a great deal more even than they contemplated accomplishing. The exhibition must be something more than a mere show of gas apparatus suitable for consumers. The Committee's circular set out a programme which, if they could find money enough to carry it out, would make a memorable show that would do good to the industry in every corner of the country. He deprecated any attempt to do anything on a magnificent scale without sufficient funds. For his own part, and speaking for the Company he represented, he should be most reluctant to contribute anything at all unless they were quite sure that there was money enough to carry out the thing thoroughly and effectively. This was not his feeling alone; and, therefore, while sharing Mr. Shadbolt's view as to what had been done in so short a time, he would urge on every member to influence his Board to comply with the minimum set out by the circular that had been distributed.

Circulation of Papers and Regulation of Discussions.

Mr. H. E. Bloor (Carlisle) moved that in future the papers be printed and circulated among the members at least ten days before the date of the meeting, and that they be taken as read; also that it be an instruction to the Council to draw up a set of regulations for the proper conduct of the discussions. In doing so, he remarked that he felt he was guilty to some extent of forwardness, as he had never presented a paper to the Institution, and was, in fact, quite a new-comer among them. This was the reason for the diffidence with which he approached the subject. At the same time, he had a very strong feeling that the view he held of the matter was the right one. The meeting in Glasgow last year was the first one that he had had the privilege of attending, though he had read the proceedings for many years with great care; and he must confess that he received a very rude shock as to the whole conduct of the meeting. The papers presented were voluminous; and the first thing that happened, so far as he could see, was that each gentleman, before commencing his paper, received a

kindly hint from the President that if he would be brief he would confer a great favour upon everybody. Some, he knew, were asked particularly to abridge their papers; and to abridge a paper on a technical subject was exceedingly difficult. It was really impossible to do it, and to at the same time give those present anything like a fair idea of the matter which the full paper was intended to put forward. The result was that some authors, finding they could not abridge their papers, read them as quickly as possible; and the discussions necessarily suffered. Everybody must feel the futility of expecting even a skilled and perfectly competent audience to grasp the full meaning of a technical paper—heavily laden with close reasoning, and in some cases embracing tables and diagrams—when it was read in this way; and the result was that frequently those attending the meeting listened with ill-disguised boredom to the reading of a paper. They might, of course, find some point they thought worth raising in the discussiion—if they found an opportunity of doing so, because the discussion had to be cut short by very reason of the reading of the paper. It was a fundamental error that the papers should be read. Furthermore, in the discussions there was apt to be considerable repetition. He therefore thought the papers should be printed well in advance of the meeting, and that some regulation should be made providing that speakers who intended to go fully into the matters dealt with in the papers should give notice, and furnish some idea of the time they would require for their remarks, and that beyond this the President should give chance speakers (say) five minutes or some other predetermined time.

Mr. Arthur Valon (London) seconded the motion.

Mr. E. A. Harman (Huddersfield) said he should prefer that the subject should take the form of a notice of motion to be moved at the next meeting.

The President suggested that it would be better if the subject were referred to the Council, as they could consider it with greater deliberation than the members generally; and then their recommendations could be brought forward next year.

Mr. Bloor said this would meet his views.

Mr. Valon having assented,

The President said the resolution would be that the matter should go forward for consideration by the Council, who should submit their report upon it at the next meeting.

This was put and carried.

Next Place of Meeting.

Mr. Corbet Woodall remarked that there was not much to be said on this subject, as he could hardly imagine that, in their Jubilee year, their meeting would be held anywhere else than in London. The fact that they had largely committed themselves to a great effort in the direction of an exhibition was another reason why they should come to London both to open it and to help it forward. He would, therefore, move that the next meeting be held in London.

Mr. Samuel Glover seconded the motion, and it was carried unanimously.

Votes of Thanks.

Mr. E. Allen (Liverpool) proposed that a hearty vote of thanks be accorded to Mr. Shadbolt, the retiring President, for his conduct in the chair during the closing session, and also for the very excellent services he had rendered to the Institution in the past year. They could not, he thought, sufficiently mark their great debt of gratitude to Mr. Shadbolt. He need not call attention to the vast volume of business that had been transacted during the year, and the great importance of many of the matters dealt with, such as the formation of the British Commercial Gas Association and the attack of the alkali manufacturers on the gas industry, to all of which the President had given his personal attention. Mr. Shadbolt had placed his very eminent gifts at the service of the Institution. His eloquence, his tactfulness, and his diplomacy had been of the greatest value; his personal qualities, the way in which he had conducted their Committee meetings, and the charming manner in which he had dealt with difficult people even at the present meeting, had revealed to them the innate qualities he possessed. He (Mr. Allen) was sure the members would agree with him that while they had had many excellent Presidents, it would be difficult to point to any President who had served the Institution better than Mr. Shadbolt had done during the past year. With the President's name he would wish to couple Mrs. Shadbolt's. What the President would be without Mrs. Shadbolt they could none of them conceive. What he was saying was perhaps gratefully anticipating favours to come. Mrs. Shadbolt was that evening going to assist the President to receive them; and it was for this reason that he had great pleasure in coupling her name with the vote of thanks. He was quite sure she had been greatly neglected during the past year, and therefore she deserved a very special vote of thanks for having been so frequently deprived of the company and attention of her most excellent husband.

Mr. A. F. Browne (London) said he felt greatly flattered in being allowed to second the vote of thanks to the President and Mrs. Shadbolt. It was well known to them all that the President had had a most strenuous year of office; and it was also well known that he had proved perfectly equal to the occasion. They had had an opportunity during the last few days of judging him as a President in the chair. They had all listened to his instructive and comprehensive address, and the first conclusion he was sure they would come to would be that they had had a gas engineer in the chair. The second conclusion they would come to he was sure, judging from the way in which they had seen him manage the business of the meeting, would be that they had had a man of business in the chair; and, beyond this, the conclusion which he had come to, and in which he was sure they would all join, was that they had a man in the chair. What a great comfort it was to have a strong man who knew just what he wanted and what it was right he should require, and who at the same time did everything in the most courteous manner. He noticed that many ladies had graced the meetings with their presence, listening to their wranglings and their speeches; and he was pleased to see that there were yet many in the gallery who had survived the ordeal.

The motion was carried by acclamation.

The President returned thanks for the vote. He said his year of office had been a very busy one, and had kept him fully employed. He would take the members into his confidence to some extent, and say that right through the year he had had the feeling in his mind that he was somewhat of an experiment. It was not often that an engineer and manager from a place the size of Grantham found himself occupying the position he had filled. When they considered that the great bulk of their members represented undertakings somewhat similar in size to his own, it could not but be felt that he was representing them all. He had felt all along that any misdemeanours on his part, any want of capacity, or any want of application, would reflect upon those who had so persistently insisted that he should occupy the chair. He had had the privilege of occupying the presidential chair in two other districts, and this had been some training to him, and had given him a little insight into the duties and the responsibilities he would have to undertake. However careful one might be, and however anxious to serve to the utmost of his abilities, one never knew what he would have to face during the year. He would like to add, with regard to the Council, that never in his experience of the old Institute or of the present Institution Council had they had one that had worked so whole-heartedly with their President in everything which concerned the benefit of their industry. Members coming from every part of the country seemed to have vied with each other in doing all they could in supporting their President, and seeing that he was backed up in what he did. Such a Council was a tower of strength to any President; and so long as they had gentlemen on the Council who would approach their duties from this standpoint, so long would their President be a success. He thanked them for coupling Mrs. Shadbolt's name with his own in the vote. It was a grateful recognition of the part a President's wife had to play during his year of office. For one thing she had to do was to keep the President in form; and, in addition, there was the neglect to which allusion had so kindly been made. Then again there was all the plotting and planning with regard to the social side of the question, in which particular, if one could judge from what had already taken place, Mrs. Shadbolt had been greatly supported by the ladies who had accepted invitations to attend.

Mr. Charles Wood (Bradford) then proposed that their best thanks be given to the Council and the Honorary Secretary for their services during the year. He said, as they all knew, the work had grown enormously; and, therefore, the least they could do was to thank the Council for the able way in which they had discharged their duties.

Mr. W. Doig Gibb (London) seconded the motion, which was carried unanimously.

Mr. J. Ferguson Bell (Derby) returned thanks on behalf of the Council. He said they had the satisfaction of knowing that they had done something to advance the interest of the gas industry.

Mr. S. Y. Shoubridge (Hon. Secretary) also returned thanks for the vote and likewise for his re-election to a position which he very much appreciated.

Mr. Arthur Valon (London) proposed a vote of thanks to the Research Committee, the authors of papers, the Scrutineers, and the Auditors.

Mr. J. P. Leather (Burnley) seconded the motion, and it was carried.

The President then proposed that a hearty vote of thanks should be accorded to the Secretary (Mr. Walter T. Dunn). Though Mr. Dunn was their paid official, he was like themselves human; and it must be very gratifying to know that the members of the Institution approved of the work he had done on their behalf.

Mr. Shoubridge, in seconding the motion, remarked that he knew perhaps better than the President how much the members of the Institution were indebted to the Secretary for his most able and conscientious labours.

The motion having been unanimously carried,

Mr. Dunn briefly returned thanks.

The President said this brought to a close the business part of their proceedings for the present year. He wished to thank all the members present most heartily for their attendance.

THE BENEVOLENT FUND.

MEETING OF DONORS AND SUBSCRIBERS.

The Annual Meeting of the Donors and Subscribers to the Benevolent Fund was held on Wednesday morning—the President in the chair.

The Hon. Secretary (Mr. Walter T. Dunn) read the minutes of the last annual meeting; and they were duly confirmed.

Mr. T. Berridge (Leamington) having proposed the reception of the annual report of the Committee of Management, a summary of which appeared in the "Journal" for the 28th ult. (p. 575),

Mr. J. Ferguson Bell (Derby), in moving its adoption, pointed out that the amount received for the fund only totalled to something like 4s. for each member of the Institution; and considering the work the fund was doing, he was quite sure it was entitled to a greater measure of support than this. He was not revealing any secrets when he said that the Committee had that morning considerably increased the sum given to necessitous cases. Those members of the Committee who were personally in contact with the cases knew the amount of good that was being done; and he considered that it was only necessary to bring the matter forward to obtain greater support. There were something like 900 members, and an annual subscription for the fund of only about £185 a year.

Mr. E. Allen (Liverpool) seconded the motion.

Mr. W. Westlake (Exeter) said he should like to have the opportunity of supporting the motion, because it had been his privilege to be in touch with one of the necessitous cases alluded to—the recipient passing away a few months ago. He could testify to the value of the fund in the case of a man who rendered great service to the gas industry in years past. But extreme misfortune came upon him, and he certainly would have had to apply for public relief if it had not been for the assistance rendered by the fund, for which the recipient was very grateful.

The President pointed out, with regard to the accounts accompanying the report, that they showed a balance on last year's working of £30 14s. But, considering that the Committee had revised the list of donations, and had increased the allowances by 17s. 6d. a week, the balance for the coming year was, he said, practically mortgaged. Fortunately, in many respects, the demands on the fund had not been so great as they had sometimes been. He could not help thinking, when Mr. Bell was speaking—good as his remarks were—that he was preaching to the converted. The business of the members present at the meeting was rather in the direction of obtaining other converts, and, consequently, contributors to the fund. If each one could, in the coming year, secure one more subscriber, Mr. Bell's wishes would be fulfilled, and they would have the contributions going up to 8s. instead of 4s. per member; and he could assure them that every penny would be required.

The report and accounts were unanimously passed.

The President announced that the retiring members of the Committee were Mr. Thomas Bower (West Hartlepool) and Mr. Hubert Pooley (Leicester). Mr. Edward Allen (Liverpool) and Mr. C. Dru Drury (Sunderland) were elected to fill the vacancies.

Mr. Allen, in returning thanks for his election, said his sympathies were always with this most important branch of the Institution.

COMMUNICATIONS READ.

INCIDENCE OF THE DAY-LOAD FACTOR.

By H. TOWNSEND, M.Inst.C.E., of Wakefield.

The Wakefield Gaslight Company, having been handicapped for many years by out-of-date legislation, making it compulsory to charge at an equal rate for gas for all purposes, determined to go to Parliament this year to get liberated from this absurd restriction, and to bring their undertaking under modern legislative conditions. Wishing to turn this emancipation to the best advantage, the author thought it desirable to investigate the day-load question, with the object of ascertaining the best means of increasing it; and thinking the experience of his neighbours would afford the most trustworthy guidance, he asked his friends, the members of the Yorkshire and Lancashire Commercial Sections, to assist him with information at their disposal. This request was readily granted; and a great number of particulars were obtained relating to about 47 separate undertakings. Some of this information could not be used, as it was either lacking in some important detail, or for other reasons mentioned later; but sufficient remained for the purpose desired.

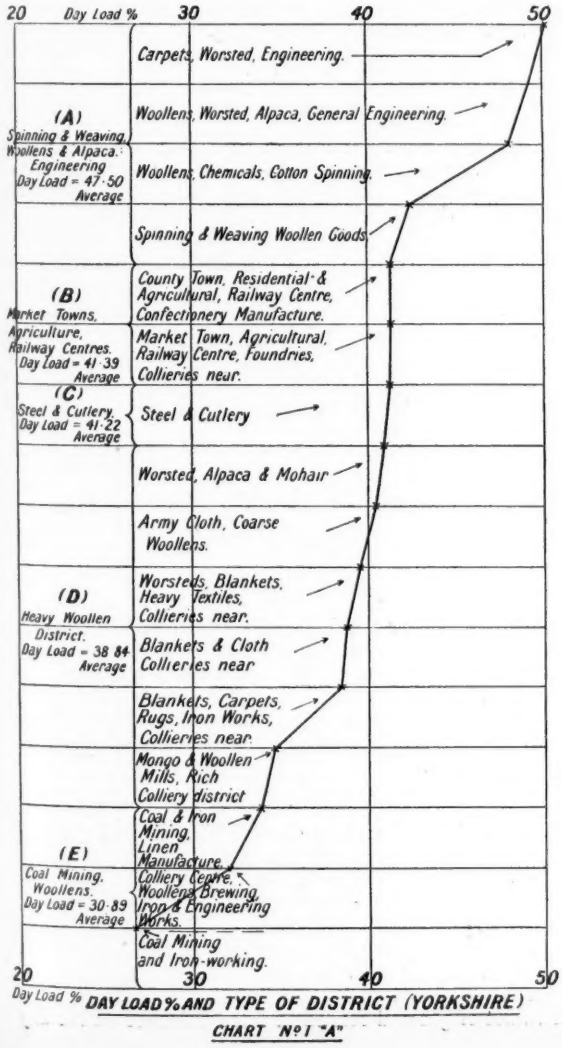
In the first place, the author decided to divide the day into two portions—viz., 6 a.m. to 6 p.m. for the day load and 6 p.m. to 6 a.m. for the night load—in order to bring his statistics into line with those of previous investigators. This, of course, is somewhat misleading, especially during the winter months, as a considerable portion of the gas used, particularly in manufacturing districts, between the hours of 6 and 8 a.m. and between 4 and 6 p.m. is employed for lighting purposes; and during the six summer months some of the gas consumed between 4 and 6 a.m. is used for cooking and purposes other than lighting. However, similar objections could be urged against any hours which might be selected in manufacturing districts; so that the author considers the times chosen are best for the purpose, especially as they include practically all the gas used for power and industrial purposes.

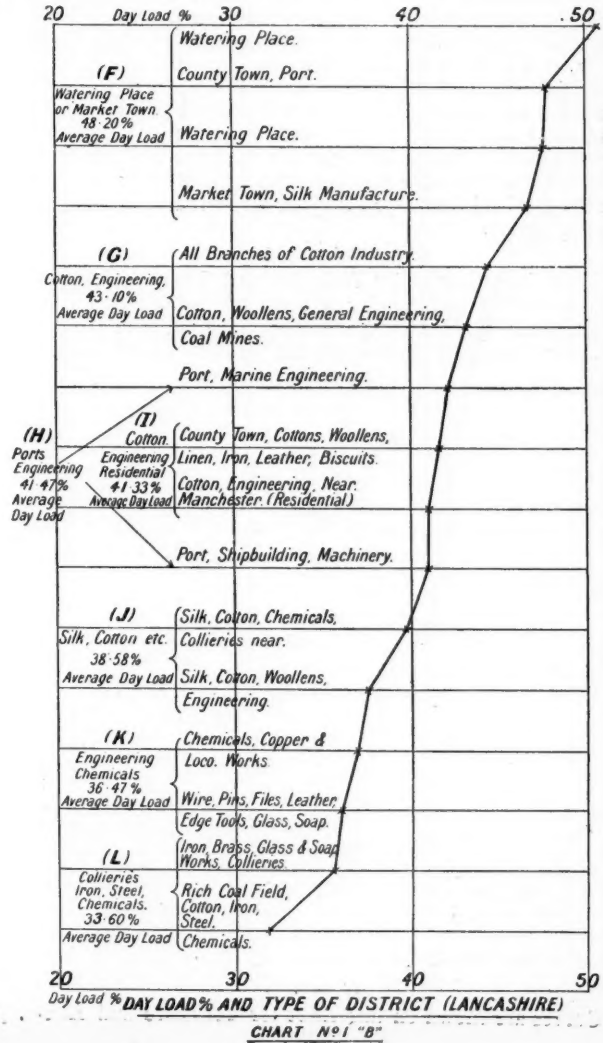
A considerable number of undertakings do not take the necessary particulars of makes and stocks to enable them to supply the information desired; so the author had to be content with those which were available. The information thus afforded is contained in the following tables, which give a great mass of particulars relating to Yorkshire and Lancashire undertakings respectively.

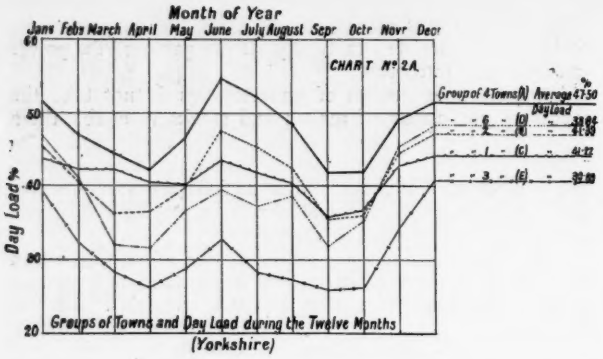
Upon looking into these statistics, the author was soon struck with the fact that there was a decided family resemblance in the day load among kindred industries. This is shown in

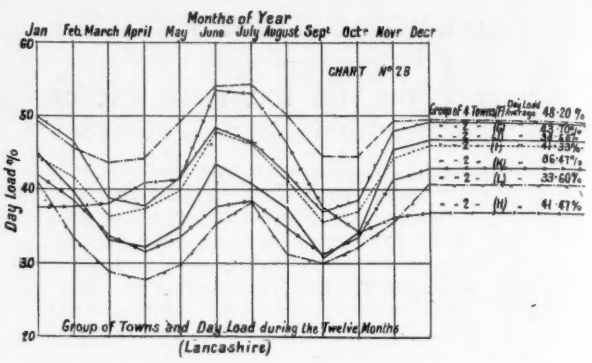
Charts Nos. 1A and 1B.

These two charts show the towns arranged in the order of the average day load for the twelve months—No. 1A referring to towns in the district of the Yorkshire Commercial Section, and No. 1B to those in that of the Lancashire Commercial Section. Upon looking at either of these charts, it is apparent that the towns form themselves into groups—towns with practically similar industries coming next to one another, the highest in each group generally having some of the industries of the group next above it in order of day load, and the lowest in a group as a rule some of the industries of the towns next below it in order of day load. Both charts point strongly to the fact that the day load is closely allied to the local industries. Thus at the head of chart No. 1A we have a group of towns manufacturing woollens and alpacas, with engineering as one of the staple trades, having an average day load of 47·50 per cent., and at the bottom of the same chart a group of towns with coal mining as the principal industry, and an average day load of only 30·89 per cent. Again, the second highest on chart No. 1B is a group of towns manufacturing cottons, with engineering as one of the staple trades, with an average day load of 43·70 per cent., and at the bottom a group of towns with coal mining


20
Day Load %
30
40
50
(A)
Spinning & Weaving Woollens & Alpaca. Engineering
Day Load = 47·50 Average
Carpets, Worsted, Engineering.
Woollens, Worsted, Alpaca, General Engineering.
Woollens, Chemicals, Cotton Spinning.
Spinning & Weaving Woollen Goods.
(B)
Market Towns, Agriculture, Railway Centres.
Day Load = 41·39 Average
County Town, Residential & Agricultural, Railway Centre, Confectionery Manufacture.
Market Town, Agricultural, Railway Centre, Foundries, Collieries near.
(C)
Steel & Cutlery
Day Load = 41·22 Average
Steel & Cutlery
Worsted, Alpaca & Mohair
Army Cloth, Coarse Woollens.
(D)
Heavy Woollen District.
Day Load = 38·84 Average
Worsteds, Blankets, Heavy Textiles, Collieries near.
Blankets & Cloth Collieries near.
Blankets, Carpets, Rugs, Iron Works, Collieries near.
Mongo & Woollen Mills, Rich Colliery district
(E)
Coal Mining, Woollens.
Day Load = 30·89 Average
Coal & Iron Mining, Linen Manufacture.
Colliery Centre, Woollens, Brewing, Iron & Engineering Works.
Coal Mining and Iron-working.
DAY LOAD % AND TYPE OF DISTRICT (YORKSHIRE)
CHART No 1 "A"




Month of Year
Jan Feb March April May June July August Sept Oct Nov Dec
CHART No 2A.
Day Load %
Groups of Towns and Day Load during the Twelve Months
(Yorkshire)


Months of Year
Jan Feb March April May June July August Sept Oct Nov Dec
CHART No 2B
Day Load %
Group of Towns and Day Load during the Twelve Months
(Lancashire)

as the principal industry and a day load of only 33·60 per cent.

The highest day load in chart No. 1B is in connection with a group of watering places and market towns, with a percentage of 48·20. There are no watering places in chart 1A; but market towns and railway centres come second in this chart, with a percentage day load of 41·39. The other groups in these two charts also serve to show that the character of the staple trade of the town has the greatest influence in determining the amount of the day load.

Charts Nos. 2A and 2B.

These charts show the average day load of the different groups of towns shown on charts Nos. 1A and 1B for each of the twelve months—No. 2A being Yorkshire, and No. 2B Lancashire. These charts show how the day load varies in the groups of towns with similar industries, and differentiates between the portion which is part lighting and part true day load (the winter months) and the part that is all true day load (the summer). It will be noticed that in all cases the day load is lower in April and September than during any other months. This seems to be due to two causes—viz., first the fact that the amount of gas sent out during the night is reduced as the days lengthen, until it is at its lowest in June, when it again increases. Thus, if the amount sent out during the daytime in April, May, June, July, and August is the same, then, on account of the diminishing night load, the percentage day load will gradually increase until it is at its highest in June, and then gradually fall away again. That this is so is amply demonstrated by these charts. The second cause is the large cooking load, which comes on in the summer and accentuates this increase in the day load from April to June and gradual diminution to September.

Chart No. 3.

This shows curves for Yorkshire and Lancashire. The towns are arranged in order of the average day load for the twelve months; and comparison is made between the day load for the twelve months and for the six summer months.

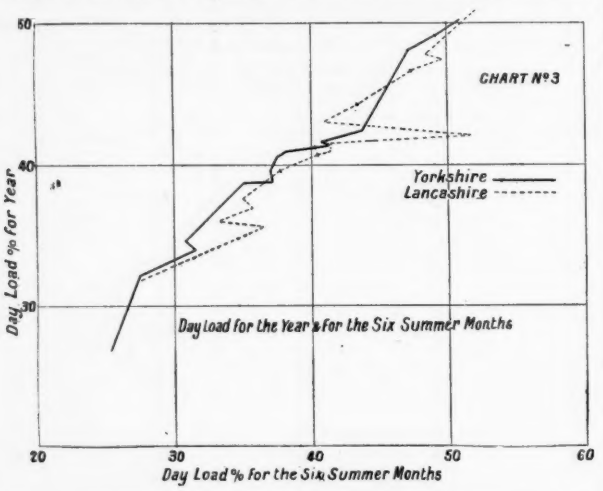


CHART No 3
Yorkshire
Lancashire
Day Load for the Year
Day Load for the Six Summer Months
Day Load % for Year
Day Load % for the Six Summer Months

It will be noticed that the towns with a large summer day load have also a large average day load for the twelve months, and those with a small day load for the twelve months have also a small summer day load.

Chart No. 4.

Curves are shown on this chart for Yorkshire and Lancashire; the towns being arranged in order of the gas consumed per head of the population, and compared with the price of gas per 1000 cubic feet for private lighting. It will be noticed that while the extremes in price and consumption go somewhat together, there is evidently some other factor which has to be taken into account, in addition to the price, in comparing the consumption per head of population. This leads to chart No. 5.

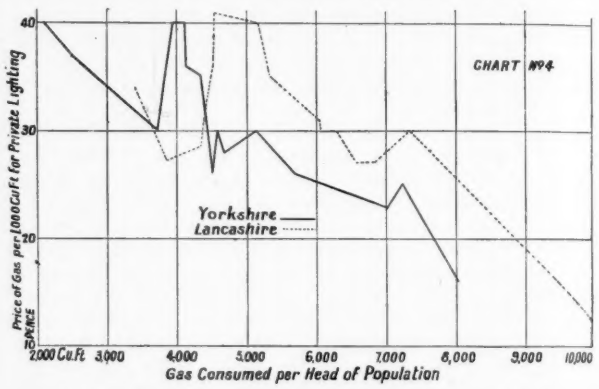
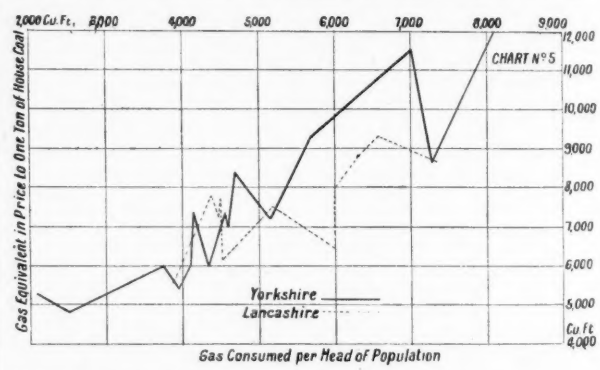


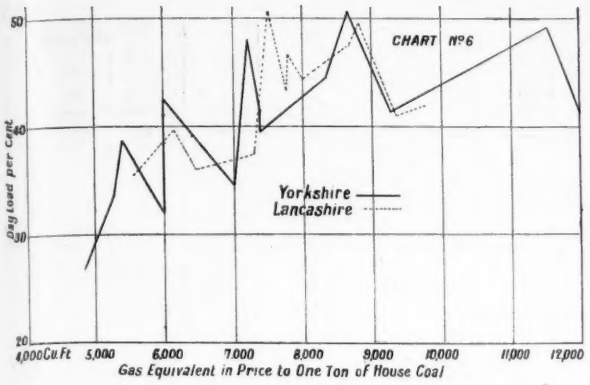
Chart No. 5.

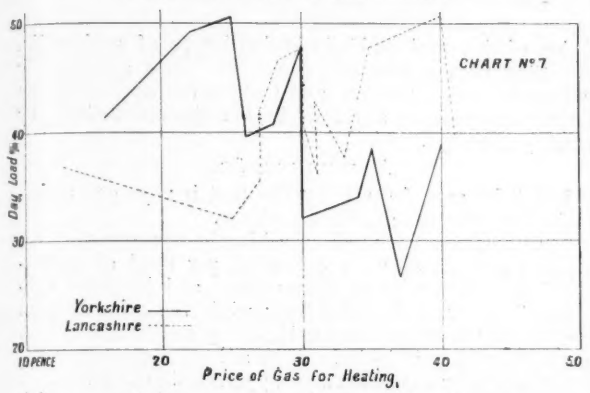
The gas consumed per head of the population compared with the gas equivalent in price to one ton of house coal is shown on this chart. It will be seen that there is some connection between these two factors—for instance, the greatest amount of gas given as the equivalent of a ton of house coal in Yorkshire coincides with the greatest amount of gas consumed per head of the population. In the case of Lancashire, however, they do not tally so closely, neither do they agree in several other cases both in Yorkshire and Lancashire. There is sufficient evidence to show that the amount of gas equivalent in price to one ton of house coal has an influence on the amount of gas consumed per head of the population.



Charts Nos. 6 and 7.

Chart No. 6 was drawn up to see if the gas equivalent in price to one ton of house coal has any direct bearing on the day load. It will be observed that the general tendency is for the day load to increase as the gas equivalent increases; but there are numerous exceptions. If we turn to chart No. 7, which compares the price of gas for heating and cooking and the day load, we find there is no apparent connection between the two—showing that the comparative local values of gas and coal exert more influence on the day

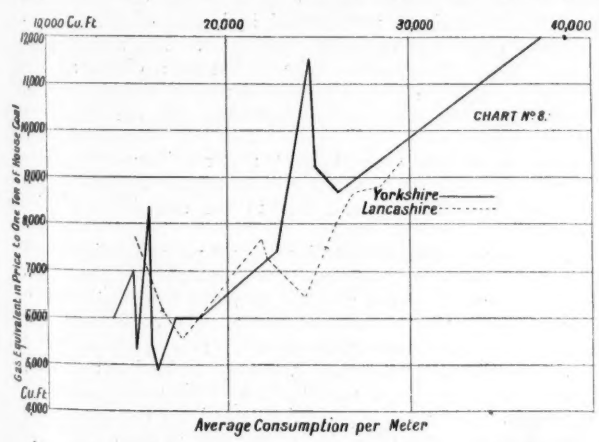


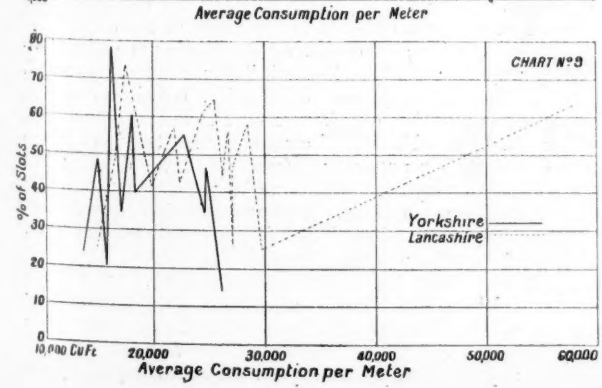


load than the price of gas for cooking. It is rather surprising to find that selling gas at very cheap rates does not necessarily imply a heavy day load. For instance, these tables include the undertakings selling the cheapest gas in the world, in one of which the day load is 41·22 per cent. and in the other 36·94 per cent.

Charts Nos. 8 and 9.

Chart No. 8 shows the gas consumed per meter compared with the gas equivalent in price to a ton of house coal, and demonstrates that the general tendency is for the average consumption per meter to increase as the equivalent increases. There are, however, several notable exceptions; and as it occurred to the author that this might have something to do with the number of slot meters, he prepared chart No. 9, which shows the average consumption per

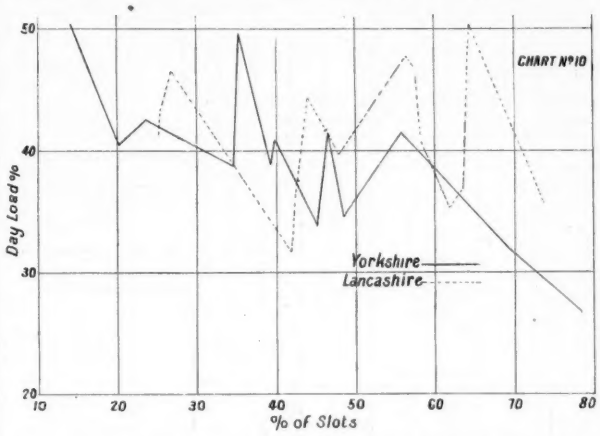




meter compared with the percentage of slots, from which it will be seen that the percentage of slots has no apparent connection with the consumption per meter, which shows the great variation there is in different districts in the average consumption through slot meters.

Chart No. 10.

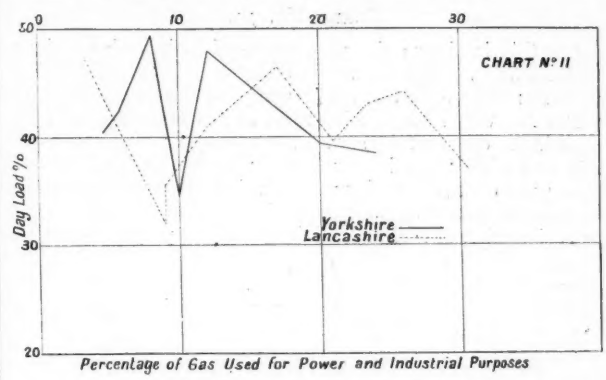
This indicates the relationship between the percentage of slot meters and the day load. In Yorkshire, there is, as a rule, a falling off in the day load as the percentage of slots



increases; but this is not borne out by the Lancashire statistics—showing the different types of consumers who use slot meters in the two counties.

Chart No. 11.

This chart indicates the percentage of gas used for power and industrial purposes compared with the day load, and is rather surprising, as it shows that a large power load does

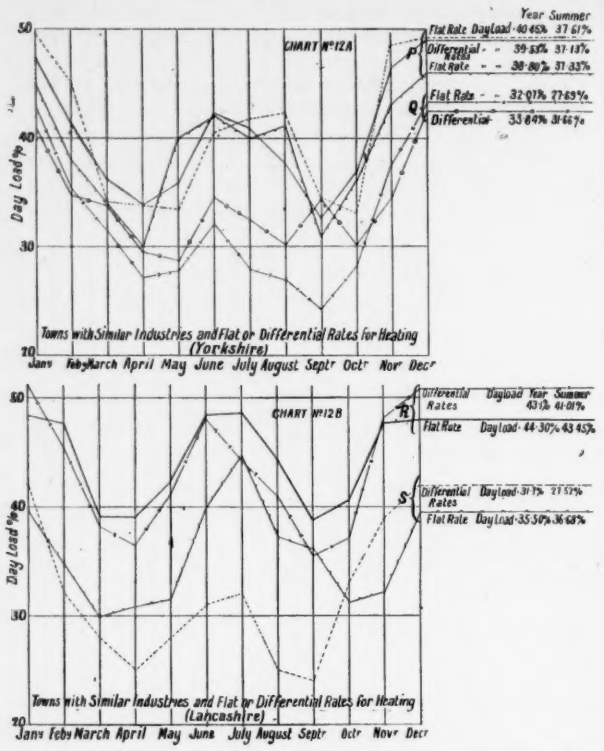


not of necessity mean a large day load. Owing to the small number of concerns able to give the percentages for power and for industrial purposes, this curve is not so instructive as the author hoped it would be.

Charts 12a and 12b.

These show groups of two or more towns with practically identical industries and flat or differential rates. The day load for the twelve months is shown, and the averages are as follows:—

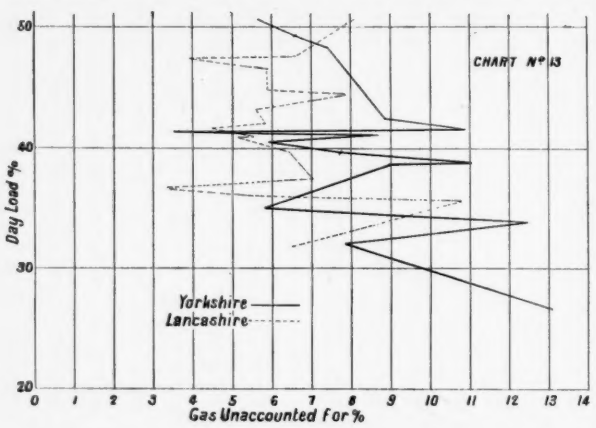
	Day Load. Year. Per Cent.		Summer. Per Cent.
12A, Yorkshire.			
Three towns "P"—			
Flat-rate	40·45	..	37·61
Differential rates	39·53	..	37·13
Flat-rate	38·80	..	37·33
For differential rates	0·73	..	..
Against " "	0·92	..	0·48 & 0·20
Two towns "Q"—			
Differential rates	33·8½	..	31·66
Flat rate	32·07	..	27·69
For differential rates	1·77	..	3·97
12B, Lancashire.			
Two towns "R"—			
Flat rate	44·30	..	43·45
Differential rates	43·10	..	41·01
Against differential rates	1·20	..	2·44
Two towns "S"—			
Flat rate	35·50	..	36·68
Differential rates	31 70	..	27·52
Against differential rates	3·80	..	9·16



It will be seen that the differential rate is accompanied by a slightly higher average day load than the flat-rate in some cases, and *vice versâ*. This seems to show that differential rates have only a slight influence on the day load.

Chart No. 13.

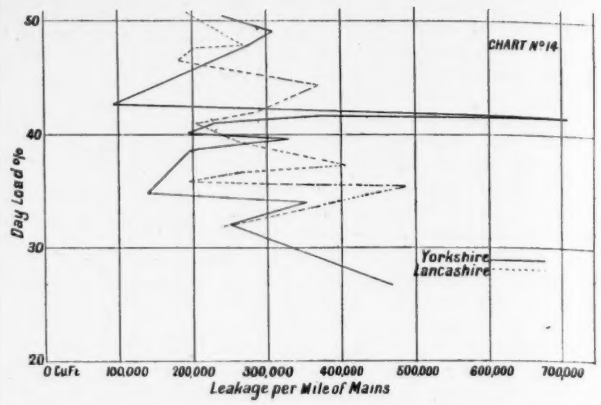
On this is shown the percentage of leakage for various undertakings. The chart was drawn up for the following reasons: Where the day load is near 50 per cent., the leakage factor has very little bearing upon it, as the leakage will be practically constant during all the twenty-four hours of the day and night; and in the case of places with a leakage of 3 to 4 per cent., the major part of this leakage will probably be due to condensation, difference in temperatures, and errors in registration of meters, and is therefore proportionate to



the output. In colliery districts, however, where, as shown, the day load is low and the true leakage is of necessity high, it is evident that, if the pressure is fairly uniform throughout the day and night, the leakage will also be uniform; but as the amount of gas sent out during the night will be much larger than during the day, the leakage will vary inversely with the output, and so tend to increase the day load and decrease the night load. In addition to the type of district, the leakage is also dependent upon the mileage of mains, which is the subject of

Chart No. 14.

Charts Nos. 13 and 14, however, show such great and unexpected variations that it is difficult to deduce from them the bearing the type of industry of a district has on leakage; and it can only be assumed that other factors come into play, such as the age, condition, and size of mains, con-



dition of the services, kind of subsoil, type of road traffic, efficiency of the measures taken to locate and remedy defects in mains, services, and meters, the contour of the district, the pressure at the works, and the undermining by colliery workings.

Advertising, &c.

It will be seen from the tables that it pays gas undertakings to advertise and push business.

Both in Yorkshire and Lancashire the concerns with the greatest amount of "gas consumed per head of population," advertise, possess show-rooms, and keep the consumers' apparatus in order free; while the concerns with the lowest "consumption per head of population," in both Yorkshire and Lancashire, neither advertise, possess show-rooms, nor keep the consumers' apparatus in order free.

Our watering places, health resorts, and towns which cater for visitors are undoubtedly the most fertile field for the day load, as the handiness of gas for cooking and heating makes it specially useful for the sudden requirements of such places. Slot meters and cookers, &c., on hire have been of the utmost advantage to the managers and landladies of hotels, pensions, boarding houses, and lodging houses, and now we have in the newly introduced "Taxi-Meter" the latest contrivance for adding to the attractions offered by those catering for the comfort of visitors. The gas industry is greatly indebted to the inventors of such ingenious appliances for ministering to the comfort and convenience of its customers.

Differential Rates.

A method of increasing business which is very popular, and which has the sanction of established custom in all branches of trade to recommend it, is that of giving preferential treatment to large consumers. The results embodied in the tables cannot be shown on a chart, as the methods of application are so varied, and are so often mixed up with discounts for prompt payment, that the effect on the day load is not easily traced. But the course recently adopted by some of our largest undertakings—especially in industrial centres, and after considerable experience of the practice—shows their belief in the soundness of the principle.

With respect to discounts for prompt payment, these are also in the tables so mixed up with discounts for large consumption that it is not possible to show the results on a chart. It is a system which has been widely adopted, and has numerous enthusiastic advocates. It has, however, not commended itself to the author, for the following reasons: Gas undertakings as a rule lose very little money through bad debts. The "Gas World Analyses" for the year 1910 give 0·12d. per 1000 cubic feet of gas sold as the average of 52 gas companies and 0·08d. of 63 municipal gas undertakings; while "Field's Analysis" for 1910 gives 0·13d. for the three Metropolitan companies, 0·09d. for eleven Suburban companies, 0·08d. for nine Provincial companies, and 0·04d. for ten Provincial corporations. Some of these give discounts for prompt payment and some do not; but there is only a very small fraction of a penny per 1000 cubic feet of gas between them. The author's Company do not give any discount; and the bad debts only amount to 0·07d., which is below the average given above.

Now, if discount for prompt payment is given at all, the least which can be offered is 2½ per cent. for payment by the end of the first month after the account is due. The experience of the author with quarterly accounts is that without any discount practically all the bills are paid by the

end of the third month after they are due; so that the 2½ per cent. discount is really paid for the use of the money for two months or less, which amounts to $6 \times 2\frac{1}{2} = 15$ per cent. per annum, whereas the banks as a rule will only allow 2 per cent. per annum interest on their customers' balances. The discount for prompt payment is usually ignored by the consumer in considering the price of gas in a locality; so that the author thinks there are better ways of dealing with the resources of a gas undertaking than by giving discounts for prompt payment. Moreover, there is invariably a residuum in every district of thriftless consumers whom nothing will cause to pay except the terrors of the law, and who require a lot of dunning on the part of collectors. So that discounts for prompt payment do not greatly reduce the expense of collection.

Having set out with the intention of learning from the tables and charts the proper place in the prosperity of an undertaking occupied by the day load, the author is driven to the conclusion that, while the day load is of very great importance, the most vital necessity is to sell as much gas per head of population in a district as possible, and that this can best be done by cheapening the price for all purposes. While the tables and charts do not seem to prove that differential prices are so remunerative as would have been expected, it is nevertheless evident that it is necessary to do our utmost to retain present business; and as our chief rival, electricity, is sold at such cut-throat prices for power, it is essential to reduce the price of gas for power below the lighting standard. In the same way it is in many cases advisable to reduce the price for public lighting. Also, if any new field for gas consumption cannot be obtained by any other means, a discount is certainly advisable. One such promising field is that of industrial purposes; and as nearly all consumers requiring industrial appliances provide their own apparatus, it is quite politic, and in most cases advisable, to give attractive discounts for gas for industrial purposes.

The day load is proved by the tables and charts to be chiefly dependent upon the character of the district supplied, and cannot be greatly increased by discount, &c.; but the author would like to point out one or two features which ought not to be overlooked in connection with it—viz., any loss of the night load by the displacement of street lamps by electric arc lamps, or the substitution of electricity for gas in lighting shops, public buildings, hotels, or private dwellings, reduces the night load, and therefore apparently increases the percentage of the day load. So that a high day load is not necessarily a healthy sign. Conversely, anything which increases the night load—such as the displacement of electric arc street lamps by high-pressure gas-lamps or the wholesale installation of either high or low pressure gas shop lamps—tends to reduce the day load. These factors must be borne in mind in considering the advantage or otherwise of apparent decreases or increases of the day load.

The view may be taken that (say) a 50 per cent. day load means economy in structural expenses. As, however, during a portion of the winter some at least, and probably the bulk, of the day load overlaps the night load, the capacity of the mains must be equal to this maximum demand; and in all industrial centres at least, owing to fogs, &c., manufacturing plant and gasholder capacity must also be able to deal with the peak of the load. Ample storage also conduces to economy in manufacture. Therefore, in industrial centres the day load does not reduce the amount of plant needed so much as might be expected.

One popular method of increasing the day load is the granting of a discount for gas used for cooking. This has many points in its favour, as the gas is mostly used for this purpose during the hours of daylight, and is employed more in summer than in winter. It, however, involves the use of another meter in most cases, and a separate set of pipes. True, the introduction of the discount meter reduces the force of this objection; but it is still there.

Another system which has been very popular has been to give substantial discounts for gas for heating. This is hardly on the same plane as gas for power, industrial purposes, or cooking, as the gas is chiefly required for heating in the winter—thus overlapping the heavy lighting load. It is, however, required most in the day time, so that it is a bit of a help in reducing the standing charges; but it has the same drawback as for cooking, in that it requires separate meter and house pipes. In this case, also, the discount meter palliates, but does not remove, the objection.

Washing boilers now seem to be in great demand. In the Industrial North, builders are beginning to abandon the provision of set pots for washing clothes, and are putting in gas washing boilers; and in a number of houses in which set pots are already installed, the tenants prefer the gas-boiler. These boilers are used all the year round, and during the hours of day light. They therefore contribute to the day load, but not to a very great extent, as washing is only done, as a rule, on one day in the week.

Gas-circulators and various types of water-heaters are also coming rapidly into favour, and promise to become an important factor in augmenting the consumption; but they are not essentially day load appliances, as they are used as much at night for baths, &c., as in the day time. Several makes are now on the market, intended to work in conjunction with the fire-back boiler and cylinder, so that hot water can be obtained all over a dwelling for baths and washing-up purposes without the necessity for a coal-fire in the kitchen.

Free Supply of Gas Appliances.

The tendency of the times seems to be for the consumer to expect all these appliances to be provided and fixed at the expense of the gas suppliers. So far as the author's experience goes, the gas consumer is quite willing to take any gas-consuming device at a low rental, but resolutely declines to purchase it. The author has done his best to push the hire-purchase of gas appliances, but with little success. Thrifty people in his district do not like hire-purchase systems; and the others who do adopt it, either become bankrupt or want him to buy the appliance back before the hire-purchase payments are completed.

The fact that several important cities have undertaken to supply gas-cookers absolutely free would seem to show that this practice is pretty general. The question therefore arises, if gas consumers require all this money spent upon them, gas undertakings cannot afford to supply them with gas at a cheaper rate also; and it would hardly seem fair to the lighting consumers for them to do so.

That this practice of supplying consumers' appliances is the trend of modern methods would seem to be borne out by the new movement on the Continent, where flat-rates for gas seem to be superseding the differential prices which used to be so general.

Another factor making for flat-rates is the fact of the great economy in the metallic filament electric lamps as compared with the old carbon lamps—an improvement which apparently has not yet exhausted itself. This makes it prudent for gas administrators to pause before giving away too much of their revenue in order to gratify their praiseworthy desire to increase the day load, as all their resources may be ultimately required so as to maintain their existing position.

Conclusion.

The conclusions to which, after carefully investigating all the circumstances, the author has arrived in this matter are:

(1) That the day load is largely a matter of locality and trade.
(2) That it is highly desirable to foster it by all sound methods.
(3) That it is wise to give substantial discounts for power and industrial purposes.
(4) That as consumers require gas appliances for heating, cooking, heating water, and other domestic uses supplied and fixed at unremunerative rates, it is not fair, in the author's case, to the lighting consumers to also supply them with gas below lighting rates.
(5) That, in view of the present trend of affairs, flat-rates in the author's case are preferable to differential prices, except in the case of power and industrial purposes.
(6) That it is better in the author's case to reduce the price of gas all round as much as possible, in preference to giving discounts either for large consumption or for prompt payment.

In other districts, where the consumers are willing to purchase their own gas appliances or to procure them on hire-purchase terms, differential rates for cooking, heating, &c., may be the best system for increasing the day load and promoting the prosperity of the concern. No hard-and-fast line can be laid down applicable to all undertakings; but a

Yorkshire Commercial Section.

—	Population of District.	Make of Gas in 1000 Cubic Feet.	Gas Accounted for.	Gas Accounted for Percentage of Make.	Unaccounted-for Gas.	
					Per Cent.	Per Mile of Main.
				Per Cent.		Cubic Feet.
1	109,500	943,164	795,924	94·38	5·60	237,000
2	50,000	374,573	350,147	93·5	6·50	305,321
3	22,000	122,265	113,243	92·61	7·39	273,380
4	9,509	42,886	39,133	91·3	8·7	91,516
5	90,000	574,072	511,895	89·17	10·83	707,086
6	53,000	259,647	241,781	93·1	6·9	363,000
7	454,653	3,812,036	3,679,997	96·54	3·46	225,410
8	..	175,622	160,519	91·40	8·6	226,409
9	38,000	191,516	178,337	94·3	5·7	194,250
10	53,358	239,908	221 694	92·4	7·68	329,637
11	6,304	27,860	24,789	89·0	11·0	204,700
12	25,000	119,476	108,423	91·08	8 92	197,500
13	25,000	121,950	114,983	94 25	5·75	139,340
14	73.392	176,338	154,455	87 6	12 4	355,035
15	73,086	295,164	272.031	92·17	7·83	250,086
16	22,000	63,837	55,489	85·92	13 08	470,300

Lancashire Commercial Section.

1	13,500	76,085	69,901	91·86	8·14	187,394
2	45,000	257,942	241,078	93·44	6·56	272,440
3	71,500	546,706	525,539	96·13	3·87	204,600
4	13,000	60,520	56,998	94·18	5·82	180,600
5	135,000	887,985	818,751	92·21	7·79	375,669
6	28,000	133,943	126,650	94·57	5·43	..
7	..	4,397,012	4,141,985	94·2	5 80	286,600
8	46,432	333,843	318,727	95·5	4·5	..
9	55,000	382,864	361,648	94·5	5·5	203,808
10	131,175	871,175	826,896	94·91	5·09	280,473
11	28,000	136,000	127,255	93·57	6·43	257,200
12	350,000	1,685,506	1,566,823	92·96	7·04	409,250
13	39,270	403,020	382,785	96·72	3·28	264,700
14	72,177	462,662	437,320	94·5	5·5	197,981
15	70,000	305 525	272 774	89·28	10·72	485,000
16	130,000	473,024	442,511	94·55	6·45	231,874

Yorkshire Commercial Section.

—	Number of Meters.		Day Load, Per Cent.						
	Ordinary.	Auto.	May.	June.	July.	August.	Sept.	Oct.	Nov.
1	26,276	4,331	50·68	56·23	53·44	48·91	43·69	46·33	52·44
2	9,191	5,003	49·03	56·12	54·28	49·25	43·98	38·80	50·67
3	3.527	2,073	46·7	53·7	52 6	48·0	39 5	43·4	50·5
4	2,181	676	38·4	52·6	48·8	47 2	40·2	38·1	42·7
5	11,009	9,600	39·6	45·7	43·5	42·2	36·2	36·2	45·0
6	4,681	5,936	40·06	49·12	47 12	42 60	34·69	36·11	44·52
7	98,736	None.	40·19	43·62	41·94	40·20	35 97	36·93	42 81
8	5.225	3,469	39·7	35 3	42·2	41·0	34·8	39·0	48·0
9	8,975	2,300	33·4	40·3	41·6	42·3	34·5	33 1	48 6
10	8,500	5,100	35·79	42·20	40 75	37·72	32·56	36·60	46 5
11	950	615	40	42	40	41	31	36	43
12	4.196	2,196	36·3	38·3	36·9	36·0	32 3	35·4	44 6
13	3,960	3,716	36·02	39·85	21·23	34·36	26 66	91·46	41·85
14	5.631	4,618	28·8	34·6	32·5	30·2	34·5	30·1	31·3
15	5 884	9,170	27 82	32·02	27·97	26·91	24·24	28·21	37·56
16	785	2,672	29·8	32·1	24·2	24·5	19·0	20·7	31

Lancashire Commercial Section.

1	968	1,773	50·94	55·55	56 91	54·50	48·66	49·73	49·88
2	3,926	5,073	49	53	54	49	45	44	50
3	14,241	5,166	49·87	54 27	54·22	50·88	43·58	42	48·15
4	1,100	1,500	46·55	53·44	52·02	47 75	41·52	42 10	48·53
5	17,608	12,778	42·3	48·6	48·7	43·3	38·8	40·4	47·8
6	6,327	2,152	41·1	48·1	44·2	41	35·3	37·1	48·3
7	69,483	60,963	52	61·5	61·6	51·4	40·1	30·9	28·4
8	6,312	5,446	40·8	47·7	45 9	41 2	35·1	36·6	44·4
9	9,119	3,081	39 08	47·84	46 27	41·39	36·42	37 49	44·20
10	12,167	16,848	42·31	45·81	44·40	41·14	34·98	37·85	43·87
11	3,997	3,688	35·5	46·5	42·4	38·7	31·7	35·1	46·4
12	40,371	29,724	34·21	40·36	39·02	35·81	29·85	33·49	44·63
13	2,807	4,863	33·72	38·58	39·42	35·28	33·66	33·79	39·10
14	6,871	11,052	33·3	37·1	37·6	34·3	28·4	33·1	43·6
15	4,065	11,481	31·4	40	44·7	37·3	36	31·2	52 1
16	2,997	9,852	28	31	32	25	24	33	39

Yorkshire Commercial Section.

—	Dec.	Jan.	Feb.	March.	April.	Average.	Price. Percentage Used for Industrial Purposes.
1	54·55	52·89	49·26	46·71	47·60	50·22	..
2	58·42	56·81	50·04	46·73	42·70	49·27	8 per cent. power only.
3	53·2	53 6	48·3	44·6	44·4	48·04	12 ,, ,, including power.
4	45	43·1	39·5	38·4	35 9	44·48	5·7 per cent.
5	47	45 5	41·5	37·6	37·8	41·48	..
6	47·07	44·98	39·11	34·97	35·46	41·31	..
7	44·14	43·88	41·27	42·39	40·31	41·22	..
8	50·8	47·7	43	34·7	35·8	41	..
9	49·2	49·6	45·2	34·1	33 6	40·45	4·6 per cent.
10	49·11	47·42	41·29	30·62	33·80	39 52	20 p.c. cooking, heating, & power.
11	46	45	38	34	30	38·80	
12	48·3	47 2	41·2	36·2	31·0	38·64	24 per cent.
13	45·88	43·85	37·86	30 01	26·80	34 65	10 ,, ,,
14	42·4	40·8	34·8	33·7	29·4	33·84	..
15	43 33	42·91	35·30	31 39	27·2	34·07	..
16	36·7	33·5	27·1	20·5	22·3	26·78	..

Lancashire Commercial Section.

1	48·21	49·62	48·54	50·44	48·29	50·77	*Nil*
2	51	50	45	42	41	47·75	..
3	49·36	47·85	44·19	41·83	45·29	47·62	3 26 per cent.
4	49·87	49·19	45·03	41·20	42·86	46·67	17·11 ,,
5	48	48·4	47·7	39·1	39	44·30	26·9 ,,
6	50·7	51·5	45·4	38·3	36·4	43 1	23·31 ,,
7	27·7	30·3	35·4	40·4	42	..	..
8	47·5	45·5	41·4	37	37 1	41·6	..
9	44·65	43·49	38·92	35·55	37·61	41·07	12 ,,
10	46	44·76	39·76	35·61	35 87	40·94	..
11	48·1	45·4	40·4	33·6	32 2	39·60	21 ,,
12	45·36	44 21	39 14	32·60	32·25	37·57	..
13	40 16	19 35	40·46	36 06	33·90	36·94	30·5 ,,
14	45·9	44·3	37·2	31·3	29·1	36·01	..
15	39·4	39·6	34·7	29·8	30·7	35·5	9 ,,
16	42	42	32	28	25	31·7	9 ,,

Yorkshire Commercial Section.
PRICE OF GAS.

—	Private Lighting.	Public Lamps.	Cooking.	Heating.	Power.	Industrial Purposes.	Slot Meters.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1	2 1	1 11	2 1	2 1	1s. 8d. to 1s. 10d.	1s. 11d. to 2s. 1d.	2 9
2	1 11	Net Cost in Borough	1 11	1 11	1s. 2d. to 1s. 8d. net	1 11	2 3
3	2 6	2 3	2 6	2 6	1s. 9d. to 2s.	1 9	3s. 6d., — 1d. per 1s.
4	3 4	3 4	3 4	3 4	3 4	3 4	3 4
5	2 2	..	2 2	2 2	2 2	2 2	2 11½
6	2 2	50s. per burner	2 2	2 2	1 11	2 2	2 5
7	1 4	1 0	1 4	1 4	1 0	1 4	None
8	3 4	2 8	3 4	3 4	3 4	3 4	3 7
9	2 4	1 6	2 4	2 4	2 1	2 1	2 9
10	3 0	Free	2 2	2 2	2 2	2 2	3 4
11	3 4	3 4	3 4	3 4	3 4	3 4	4 2
12	2 11	2 9	2 11	2 11	2s. 6d. to 2s. 11d.	2s. 6d. special case	3 4
13	2 6	2 6	2 6	2 6	2 6	2 6	3 1
14	3 4	2 10	2 10	2 10	2 3	2 10	3 9½
15	2 6	2 6	2 6	2 6	2 6	2 6	3 4
16	3 1	2 8	3 1	3 1	3 1	3 1	3 11

Lancashire Commercial Section.

	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1	3 4	2 0	3 4	3 4	3 4	3 4	3s. 9d. to 4s. 2d.
2	2 11	2 6	2 11	2 11	2 0	2 11	3 4
3	2 6	2 2	2 6	2 6	2s. & 2s. 6d.	2 6	30 ft. per 1d.
4	2 4½	Cost Price	2 4½	2 4½	1 10½	1 10½	2s. 11d. & 2s. 8½d.
5	2 6	About 1s. 9d.	2 6	2 6	2 6	2 6	3s., 3s. 4d. less 1½d. in 1s.
6	3 0	2 3	2 7	2 7	2s. 3d. to 2s. 7d.	2s. 3d. to 2s. 7d.	3 5
7	2 3	2 3	2 3	2 3	2 3	2 3	2 10
8	2 3	Compounded	2 3	2 3	2 3	2 3	2 6
9	2 3	2 3	2 3	2 3	2 1	2 1	2 9
10	2 6	Rate per lamp	2 6	2 6	1s. 9d. to 2s.	2 6	3 4
11	3 5	2 6	3 5	3 5	2s. 9d. to 3s. 1d.	3 5	3 7½
12	2 9	2 9	2 9	2 9	2 9	2 9	2 9
13	1 1	Free	1 1	1 1	0 11	..	1 6½
14	2s. 7d. to 4s. 9d.	1 11	2 7	2 7	2 7	2 7	2s. 6d. to 3s. 9d.
15	2s. 3d. & 2s. 6d.	Free in Borough	2s. 3d. to 2s. 6d.	2s. 3d. to 2s. 6d.	1s. 6d. to 1s. 10d.	..	3s. to 3s. 4d.
16	2 10	2 10	2 1	2 1	2 1	2s. 10d. to 2s. 1d.	30 ft. per 1d.

Yorkshire Commercial Section.
Discount for Large Consumption.

—	Private Lighting.	Public Lamps.	Cooking.	Heating.	Power.	Industrial Purposes.
1	2	2d. per 1000 cub. ft.	2	2	2	2
2	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
3	2d. per 1000	*Nil*	1d. per 1000	1d. per 1000	1d. per 1000	1d. per 1000
4	200,000 per annum = 5 per cent. up to 600,000 12½ per cent.			Do.	Do.	Do.
5	250,000 = 1d. per 1000 up to 1,000,000 = 3d. per 1000.			Do.	Do.	Do.
6	Do.	*Nil*	remainder 5 per cent. off £50 to £75 annual accounts. 10 per cent. off £75 and over annual accounts.			
7	1d. to 4d.	1d. to 4d.	1d. to 4d.	1d. to 4d.	1d. to 4d.	1d. to 4d.
8	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
9	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
10	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
11	4d. per 1000 up to 100,000 &c. to 1,500,000, 1s. 1d.		4d., &c.	4d., &c.	6d., &c.	4d., &c.
12	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
13	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
14	1d. to 6d. per 1000	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
15	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
16	6d. per 1000	Net	Net	Net	6d.	Net

Lancashire Commercial Section.

1	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
2	1d. to 6d.	*Nil*	1d. to 6d.	1d. to 6d.	*Nil*	1d. to 6d.
3	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
4	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
5	None	*Nil*	*Nil*	*Nil*	Up to 1s. 1d. per million	Up to 1s. 1d. per million
6	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
7	*Nil*	10 per cent.	*Nil*	*Nil*	*Nil*	*Nil*
8	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
9	1d. to 2d.	*Nil*	1d. to 2d.	1d. to 2d.	1d. to 2d.	1d. to 2d.
10	2½ to 5 per cent.	*Nil*	2½ per cent. 1 to 5 millions, 5 per cent.		over 5 millions.	2½ to 5 per cent.
11	2d. and 4d.	*Nil*	2d. and 4d.	2d. and 4d.	2d. and 4d.	2d. and 4d.
12	Up to 4d.	Up to 4d.	Up to 4d. per 1000	Up to 4d.	Up to 4d.	Up to 4d.
13	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
14	*Nil*	*Nil*	*Nil*	*Nil*	1d. to 6d. remainder *nil*	*Nil*
15	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
16	10 per cent.	10 per cent.	10 per cent.	10 per cent.	10 per cent.	10 per cent.

Yorkshire Commercial Section.
Discount for Prompt Payment per 1000 Cubic Feet.

—	Private Lighting.	Public Lamps.	Cooking.	Heating.	Power.	Industrial Purposes.
1	An additional	penny per	1000 cubic	feet beyond	the previous	allowance
2	5 per cent.	Net	5 per cent.	5 per cent.	Net	5 per cent.
3	1d.	*Nil*	1d.	1d.	1d.	1d.
4	5d.	5d.	7½d.	7½d.	7½d.	7½d.
5	*Nil*	*Nil*	*Nil*	*Nil*	10 per cent.	*Nil*
6	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
7	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
8	2d.	*Nil*	2d.	2d.	2d.	2d.
9	5d.	*Nil*	5d.	5d.	5d.	5d.
10	2½ per cent.	Free	2½ per cent.	2½ per cent.	2½ per cent.	2½ per cent.
11	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
12	5d.	5d.	5d.	5d.	5d.	5d.
13	5, 7½, 10 per cent.	10 per cent.	25 per cent.	25 per cent.	25 per cent.	25 per cent.
14	2½ per cent.	2½ per cent.	2½ per cent.	2½ per cent.	2½ per cent.	2½ per cent.
15	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
16	2d.	Net	2d.	2d.	Net	2d.

Lancashire Commercial Section.

1	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
2	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
3	5 per cent.	None	5 per cent.	5 per cent.	5 per cent.	5 per cent.
4	5 per cent.	Net	5 per cent.	5 per cent.	5 per cent.	5 per cent.
5	3d.	2d.	2d.	2d.	2d.	2d.
6	3d.	3d.	3d.	3d.	3d.	3d.
7	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
8	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
9	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
10	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
11	2d.	*Nil*	2d.	2d.	2d.	2d.
12	4d.	4d.	4d.	4d.	4d.	4d.
13	2d.	*Nil*	2d.	2d.	2d.	2d.
14	6d. to 1s. 6d.	6d. to 1s. 6d.	6d. to 1s. 6d.	6d. to 1s. 6d.	6d. to 1s. 6d.	6d. to 1s. 6d.
15	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
16	10 per cent.	10 per cent.	10 per cent.	10 per cent.	10 per cent.	10 per cent.

Yorkshire Commercial Section.

—	Do you Charge for Fixing or Fix Free with Ordinary Meters?			
	Services.	Cookers.	Fires.	Grillers.
1	Free to 10 yds.	Fixed free	Charge	Free
2	Free to 10 yds.	Free if ours	Charged for	Charged for
3	Free	Free	Free	Free
4	Free to 10 yds.	Free	Charge	Free
5	Free	Free	Free	Free
6	Free to boundary	Free	Charge	Charge
7	Free	Charge	Charge	Charge
8	Free to 10 yds.	Free	Free	Nil
9	Free	Free	Charge	Charge
10	Free to 20 yds.	Charge	Sale	Not supplied
11	Free	Free	Free	Free
12	Free	Free	Free	Charge
13	Free to boundary	Free	Charge	Free
14	Free	Free	Charge	Charge
15	Free to 25 yds.	Free	Free	Charge
16	Free	Free	Free	Free

Lancashire Commercial Section.

1	Free to 40 ft.	No	Yes	Yes
2	Free	Free	Free at list price	..
3	Free to 60 ft.	Free	Free	Free
4	Free to 30 ft.	Free to 15 ft.	Charge	Charge
5	Charge on private land	Free	List price fixed free	Free
6	Free	Free to slots	Free	Free
7	Charge for	all work	on private	property
8	Charge	Charge	Charge	Charge
9	Charge on private property	Free to 40 ft.	Free to 20 ft.	Free to 20 ft.
10	Free to 30 ft.	Free	Free	*Nil*
11	Free	Free	Free	Free
12	Free to 30 ft.	Free if on hire	Charge	Charge
13	Free	Free	Free	Free
14	Charge	Free to 30 ft.	..	..
15	Free to 25 ft.	50 ft. free	Charge	Charge
16	Charge on private ground	Free	Charge	Charge

Yorkshire Commercial Section.

—	Do you Supply Free or on Hire?				
	Cookers.	Fires.	Grillers.	Shop Lamps.	Engines on Hire Purchase.
1	Hire	Sale	Hire	Not supplied	No
2	Hire, free to slots	Sale	Free with slots	No	No
3	Hire	Hire	Free	Hire	Yes
4	Hire	Sale	Free	Sale	No
5	Hire	Hire	Hire	Sale, fixed free	No
6	Hire purchase	No	No	No	No
7	Hire	Sale	Sale	Sale	No
8	Hire	Hire purchase	Sale	Sale	No
9	Hire	Sale	Sale	No	No
10	Hire purchase	Sale	Sale	Not supplied	No
11	Hire	No	No	No	No
12	Hire, free to slots	Hire purchase	*Nil*	Hire purchase	Yes
13	Hire	Sale	Free	Hire	Yes
14	Hire purchase	Sale	Sale	Sale	No
15	Hire, free to slots	Hire	Hire, free to slots	Hire	Yes
16	Hire, free to slots	Free	Hire, free to slots	No	No

Lancashire Commercial Section.

1	Hire	No	No	No	No
2	Hire, free to slots	Hire	Sale	Hire purchase	Yes, but no applicants
3	Hire	Hire purchase	Hire	Hire purchase	No
4	Hire	Sale	Free	Sale	No
5	Hire	Sale	Hire, free to slots	No	No
6	Hire, slots free	Free	Free	Hire	Yes
7	Hire	Hire	No	No	No
8	Hire purchase	Hire purchase	No	No	No
9	Hire	No	Free	No	No
10	Hire	Hire	No	Hire purchase	Yes
11	Free	Sale	Free	Sale	No
12	Hire	No	No	No	No
13	Hire	Sale	Sale	Sale	No
14	Hire purchase	Sale	Sale	Sale	No
15	Hire, free to slots	Sale	Sale	Sale	No
16	Hire	Hire purchase	No	No	No

Yorkshire Commercial Section.

—	Do You Charge Rent for Meters?	Do You Supply Discount Meters?	Price of Electricity. Lighting.	Price of Electricity. Power.	Price of Screened House Coal per Ton.
1	Yes	No	4d.	⅞d. to 2d.	18s.
2	Yes	No	3d. to 4½d.	⅜d. to 2d.	22s. 1d.
3	Yes	No	4d.	⅜d. to 2d.	18s.
4	Yes	Yes	No public	electricity.	20s.
5	Yes	Yes	3½d. to 4½d.	1d. to 1½d.	20s.
6	No	No	3d. to 5d.	1½d. to 2d.	16s.
7	Yes	No	2d. to 4d.	·6d. to 1d.	16s.
8	Yes	No	4½d.	1½d.	20s.
9	Yes	No	6d. per unit to 2d. per unit.	1d. to 3d.	19s. 6d.
10	Yes	No	4d. less discount.	1d. to 2½d.	16s.
11	Yes	No	5d.	Private contracts	18s. (average.)
12	Yes	No	⅞d. to 4d.	⅞d. to 2d.	17s. 6d.
13	Yes	No	5d.	0d. to 1½d.	17s. 6d.
14	Yes	No	2d. to 4½d.	1½d.	15s.
15	Yes	No	3½d. to 4½d.	1d. to 2d.	15s.
16	Yes	No	None.	None.	15s.

Lancashire Commercial Section.

1	Yes	No	5d.	3d.	25s.
2	No	No	3½d.	1d.	..
3	No	No	4d.	2d.	21s. 8d.
4	Yes	No	None	None	18s. 6d.
5	No	Supplied free	4d.	·6d. to ·75d.	20s.
6	No	No	4½d. & 3d. to 6d.	⅞d. to 1½d.	20s.
7	Yes	No	2½d. to 3½d.	1d. to 6d.	22s.
8	No	No	3½d. to 5d.	Not known	..
9	No, except as stand-by	No	4½d.	1½d.	21s.
10	No	No	4d.	1d. to 1½d.	22s.
11	No	No	3d. to 4d.	1d. to 2d.	21s.
12	No	No	3½d.	1d. per H.P. per hour, current at ½d.	20s.
13	Yes	No	1½d. to 4d.	⅜d. to 1½d.	..
14	Yes	No	4d., less 5½ per cent.	4d., less discount.	16s. 8d.
15	Yes	No	4d., less 2½ per cent.	1d. to 1½d.	12s. 6d.
16	No	No	3d. to 5d.	1d. to 2d.	..

Yorkshire Commercial Section.

—	Have you Show-Rooms?	Do you keep Apparatus in Order Free?	Do you Advertise?	Gas Consumed per Head of Population.
1	Yes	Only our own	No	7268
2	Yes	If our property	Occasionally	7003
3	Yes	Yes	Yes	5147
4	Yes	Yes	Yes	4115
5	Yes	No	Yes	5697
6	No	Cookers only	No	4562
7	Yes	Yes	Yes	8094
8	No	Yes, if ours	No	..
9	Yes	Yes	No	4693
10	Yes	No	No	4154
11	No	Yes	No	3932
12	Yes	Yes	Yes	4336
13	Yes	Yes	Yes	4599
14	Yes	No	No	2104
15	Yes	Yes	Yes	3722
16	No	Yes	Yes	2522

Lancashire Commercial Section.

1	No	Yes	Yes, a little	5177
2	Yes	No	Yes	5357
3	Yes	Yes	Yes	7350
4	Yes	Yes, cookers and grillers	Yes	4384
5	Yes	Yes, our own	Very little	6064
6	Yes	Yes	Yes	4523
7	Yes	Yes, if on hire	Yes	..
8	Yes	No	Yes	6864
9	Yes	Yes	Yes	6575
10	Yes	Yes, if on hire	No	6303
11	No	Yes	No	4544
12	Yes	Yes, if on hire	Yes	4476
13	Yes	Yes	Yes	9925
14	Yes	No	No	6058
15	Yes	Yes, if on hire	Rarely	3896
16	No	Cookers only	No	3403

Yorkshire Commercial Section.

—	Gas Equivalent to One Ton of House Coal.	Average Consumption Per Meter.	Slot Meters Per Cent. of Total Number of Meters.	Day Load During 6 Summer Months, April to Sept.
			Per Cent.	Per Cent.
1	8,640	26,004	14·1	50·09
2	11,521	24,668	35·2	49·22
3	7,200	20,221	37·0	47·15
4	6,000	13,697	23·6	43·85
5	9,230	24,838	46·5	40 85
6	7,384	22,773	55·9	41·50
7	12,000	37,271	No slots	40·37
8	6,000	18,463	39·9	38·10
9	8,357	15,817	20·4	37·61
10	7,384	16.301	37·5	37·13
11	5,400	15,839	39·2	37·33
12	6,000	17,123	34·6	35·13
13	7,000	14,979	48·4	30·82
14	5,294	15,070	45·0	31·66
15	6,000	18,070	60·9	27·69
16	4,864	16,286	78·4	25·31

Lancashire Commercial Section.

1	7,500	25,501	64·6	52·14
2	..	26,789	56·3	48·5
3	8,666	27,079	26·6	49·68
4	7,789	21,922	57·6	47·35
5	8,000	26,090	43·9	43·45
6	7,742	14,936	25·3	41·01
7	9,777	31,825	46·6	51·81
8	..	27,107	46·3	41·30
9	9,333	29,642	25·2	41·43
10	8,800	28,498	58·0	40·66
11	6,146	16,558	47·9	37·83
12	7,272	22,352	42·4	35·25
13	..	50,819	63·4	35·75
14	6,451	24,399	61·6	33·30
15	5,555	17,546	73·9	36·68
16	..	19,800	41·8	27·52

Yorkshire Commercial Section.

INDUSTRY OF DISTRICT.

1. Carpets, worsted, engineering.
2. Woollens, worsted, alpaca, and general engineering.
3. Woollens, chemicals, cotton spinning.
4. Spinning and weaving of woollen goods.
5. County town, residential and agricultural, railway centre, confectionery manufacture.
6. Market town, agricultural, railway locomotive works, few foundries, collieries in neighbourhood.
7. Steel and cutlery.
8. Woollen district, worsted, alpaca, and mohair.
9. Woollen district, army cloth, coarse woollens.
10. Woollen district, worsteds, blankets, heavy textiles, coal pits in neighbourhood.
11. Blankets and Cloth, collieries in neighbourhood.
12. Blankets, carpets, rugs, iron and machine works, collieries in neighbourhood.
13. Mongo and woollen mills, rich colliery district.
14. Coal and iron mining, linen manufacture.
15. Colliery centre, woollens, worsteds, brewing, iron, and steel works, &c.
16. Coal mining and iron working.

Lancashire Commercial Section.

1. Watering-place.
2. Residential, county town, port.
3. Watering-place.
4. Market town, silk manufacture.
5. All branches of cotton industry.
6. Cotton, woollens, general engineering, coal mines.
7. Port, marine engineering.
8. County town, cottons, woollens, linens, iron, leather, biscuits, &c.
9. Cotton, engineering, &c. (near Manchester).
10. Port, shipbuilding, and machinery.
11. Silk, cotton, chemicals, collieries in neighbourhood.
12. Cottons, woollens, silks, engineering, &c.
13. Chemicals, copper works, locomotive works.
14. Wire, pins, files, edge tools, leather, glass, soap, &c.
15. Iron and brass works, glass, soap, pottery, colliery district.
16. Rich coalfield, cotton, iron, steel, chemical works, &c.

considerable amount of latitude is desirable and necessary in dealing with this important problem.

In conclusion, the author begs to thank the members of the Yorkshire and Lancashire Commercial Sections for their kindness in providing the particulars which form the basis of this paper, and his Assistant, Mr. C. V. Townsend, for having prepared the tables and charts.

Discussion.

Mr. J. P. Leather (Burnley): I have not a great deal to say on this matter; but I have compared the figures given by Mr. Townsend with the figures of my own undertaking, which, though I am in Lancashire, is not included in the list. Our average day load is 46·8 per cent.; so we are fairly well up. There are three undertakings in each of the counties mentioned in Mr. Townsend's paper that are higher, and only three. There is one thing I noticed, but perhaps it is hardly necessary to name it, because I do not want to take up too much time. It was that in our case the maximum day load is in the winter time. Taking the months in the same way as Mr. Townsend has taken them, our biggest figures are in December and January, rather than in June—that is to say, they are slightly higher. I think there are no cases that Mr. Townsend has given where the same thing applies. It simply points to what Mr. Townsend has said, that local conditions affect this question very much. It is probably because we have a very considerable lighting load, which stops absolutely at 5.30, and does not start till 6 o'clock in the morning in the winter time—a very considerable proportion of day load, perhaps more so than any other town in the list, cotton-weaving being almost the only industry, except to some extent loom manufacturing, and things of that kind. A great deal of gas is used, because every loom must have a good light, and that light is only in the winter time—starting in October and finishing in February. It becomes a day load, though it is a lighting load; and that is the reason we come to over 50 per cent. in December, 53 per cent. in January, 52·4 per cent. in February, and in June 51·3 per cent. It is rather as a matter of comparison than anything else, showing that local conditions do vary tremendously. I have no doubt that everyone who is mentioned in this table, and who seems to have rather a heavy day load factor, would be able to give local reasons for it. Then with regard to the questions referred to by Mr. Townsend, of the supply of gas appliances. He says that he has not been able to do anything on hire-purchase, that he has to do it all by hire, and giving as much as possible. With us we have twenty times as many cookers in use that have been sold on the hire-purchase system as we have simply on hire, and half the number have been sold direct. That is, in round figures, 3000 sold direct since we started, 6000 sold on hire-purchase, and 300 on hire. Thus local circumstances do affect very much this question.

Mr. W. B. M'Lusky (Halifax): I do not propose to take part in the discussion to any extent. The paper deals with a subject of very great importance to gas undertakings at the present time. I have been greatly surprised to find that the author has taken such a pessimistic view as he has done. In the opening paragraph, he says his company deemed it expedient to go to Parliament to rid themselves of absurd restrictions; and after being rid of these absurd restrictions, the author says that he finds it expedient to pause. It seems to me that the text of the paper should have been "Pause." This conclusion is arrived at from the part where the author says, after reviewing the whole situation, he finds it expedient for gas administrators to pause before giving away too much of their revenue in order to gratify their praiseworthy desire to increase the day load. In the same paragraph he says that gas undertakings ought to preserve their resources in view of the advent of the metallic filament lamp. This gentleman warned gas undertakings against the terrible innovation of the metallic filament lamp, which, compared with the system advocated in the paper, is worth about £7 10s. against £100 for gas. This is a thing that you are warned against; this is the thing that has come to invade our business; and this is the thing to give us pause. In the same paper we are warned against giving gas consumers facilities in the use of gas-cookers which would cost the consumer or the undertaking 1d. or 1½d. per 1000 cubic feet; and at the same time we are warned against the terrible metallic filament lamp that has come to invade us. From beginning to end, I have been trying to discover what the object of the paper is—what it was written for; and I hope in reply Mr. Townsend will tell us his views, because the paper has failed to do so. In my opinion, any paper presented to the Institution ought to give us, right in the forefront of it, the author's own views. Why is he afraid to give the consumers facilities, and where are all those consumers who are not to be trusted with gas-cookers, but who are to become purchasers, and where are those who hire-purchased them and have become bankrupt since they did so?

Mr. J. Ferguson Bell (Derby): The author commences his paper by pointing out that his Company have been handicapped for many years through having to work under out-of-date legislation. It seems to me unwise for any company or corporation to continue working under obsolete measures; and the question arises, Why did they not approach Parliament sooner, and so get rid of obsolete legislative restrictions, as they simply penalize the consumers and restrict commercial enterprise, which is the life, I may say, of any successful undertaking. I can congratulate the author on obtaining his emancipation; and no doubt he will find the cost of going to Parliament was money well expended. I believe that this is the first paper that we have had submitted to the Institution on the very important subject of load factor. The term was coined by Mr. Crompton, and more than twenty years ago in a Presidential Address by the late Dr. John Hopkinson, when President of the Junior Institution of Engineers. Since that time the word has been constantly in the mouths of our friends the electrical engineers, resulting in some most extraordinary deductions, especially by corporations, many of whom appear more concerned with the volume of business, or the number of units generated, than with sound commercial principles. However, there is no doubt that this question of the load factor is a most important one, because in all undertakings I think there are three incidents with reference to expenditure. One is the interest on the capital expenditure, which is constant, whatever the volume of business done. The next is what we may call the fixed charges—that is to say, for maintenance and repairs—which vary only very indirectly with the business done; and then we have the third charge, which varies directly in proportion to the business—I mean the cost of coal, carbonizing, and purifying expenses. In all gas undertakings these three classes of charges vary considerably. They vary in different undertakings; and, of course, in reference to gas undertakings they vary. After a careful perusal of this paper of Mr. Townsend's, I looked up "Field's Analysis," to see how these charges could vary; and I tried to calculate them out as bearing on the gas industry. Now, I find by reference to that very admirable publication, "Field's Analysis," that the load factor—that is, the maximum output per diem compared with the total quantity during the year—is for corporations 1 to 210, and for companies 1 to 227. The London and Suburban Gas Companies have a slightly better load factor—being 1 to 231 and 1 to 248 respectively, due perhaps to later hours, and no doubt a more general adoption of gas for cooking and heating purposes. I think the people in London stop up a little later than we do in the country. However that may be, I notice, turning back for five years and taking "Field's Analysis" for 1907, in all cases the load factor during the five years has very considerably improved. Now I find, referring again to "Field's Analysis," that during 1911 the average price for gas and meter-rents for the provincial gas companies was just under 24d. per 1000 cubic feet of gas sold. I have tried to divide this out, and ascertain how it is made up; and I find that 6d. represents the cost of coal and carbonizing expenses, and therefore that is a charge that will vary directly according to the consumption. Then 10d. is the cost of repairs and maintenance, and what to a large extent may be called standing charges. This, of course, varies only indirectly according to the consumption. The capital charge is 8d. per 1000 cubic feet sold; and this, of course, is a constant charge whether we have a good load factor or a poor one. Therefore, applying these figures, I find that if it were possible to increase the load factor by 50 per cent., we could reduce our charge for gas by 25 per cent. Now, I think this is a very important thing for us to remember. The author tells us that the question of load factor is more a question of the position and industries of the town. I agree with this to a certain extent; but I think it is possible for us all, by consistent effort and by advertising, to very considerably improve our load factor. In the case of Derby, I find during the last five years we have improved our load

factor by something like 10 per cent., we have increased our consumption by 20 per cent., and decreased our charges by something like 10 per cent. All this points to the great importance of our studying the load factor. The author has given us the load factor during the different hours, and he has taken an arbitrary time from 6 a.m. to 6 p.m. I think if he had given us, on the lines of "Field's Analysis," the maximum amount as compared with the total, that it would have been more interesting, and it would have added somewhat to the value of the paper. But the fact that, I think, the author has not put sufficient stress upon is that where in this table we have very cheap gas, there we have the largest sale per head of the population, and this is a very important thing. The author also points out with reference to the tables that, where we have dear gas, there we have a small consumption per head of the population. In this connection, I may perhaps say that I look forward to the efforts which are now being put forth by the British Commercial Gas Association to very much improve our position with reference to the day load, and that we shall be able largely to increase the amount of gas that we sell for other than lighting purposes. I should like to express my obligation to the author for the immense amount of work he has put into the paper. I consider it one of the most interesting and most instructive papers that have ever been brought before the Institution.

Mr. Edward Allen (Liverpool): I agree with Mr. Bell that the Institution are indebted to Mr. Townsend for his paper, which indicates a striking feature in the present policy of the industry—that is, the keen determination to extend our business in every possible direction. In this connection, the day load represents a field that may be expected to repay cultivation and yield an abundant harvest. The author has shown great industry in collecting and collating the statistics of the gas undertakings in the Lancashire and Yorkshire Commercial Sections, or may be I should take his order and say Yorkshire and Lancashire sections. These figures deserve very careful examination by us, and furnish data for the solution of various problems. They are only valuable to those who can make proper use of them; and it is quite probable that many of the conclusions drawn will not agree with those of the author. The importance of increasing the day load goes without saying. It is also true that circumstances are more favourable to this in some districts than in others. Opinions differ as to the best means for increasing the output; and even the author gives opinions that are in opposition. For instance, he says "(3) It is wise to give substantial discounts for power and industrial purposes." "(5) Flat rates in the author's case are preferable to differential prices." In my opinion, it is wise to make some allowance for any new class of business that can be acquired by such means, or that needs special treatment for its further development. At the same time, care should be taken that the ordinary business should not be unduly burdened by such a policy. Having regard to my own district [Liverpool], I notice that the day load shown (No. 7) is on the average 42 per cent., and is midway on the list of Lancashire cases. During the three summer months—June, July, August—the average is 58 per cent., which is the highest figure on the tables for that period. I cannot, however, claim any superiority for Liverpool in this respect at present, though strenuous efforts are being made to develop the day load by means of gas-cookers, gas-fires, &c. The explanation of the high percentage shown on the table will be found, I think, in the fact that the day load return refers to the gas distributed between daylight and dusk, not 6 a.m. to 6 p.m. To-day, for instance, the hours between sunrise and sunset are 3.50 a.m. to 8.31 p.m.—nearly seventeen hours—leaving only seven hours for the night load. The author will most probably look into this matter, and make the necessary correction. If case No. 7 is the only one in error, the lines on the charts may not be affected to any practical extent. Early in the paper, the author states that "in all cases the day load is lower in April and September than during any other months." But in Liverpool, April is 44·3 per cent., and September 40·1 per cent.; but the minimum is in December 27·7 per cent., and is explained by the fact that on Dec. 15 the sun rises at 8.24 a.m. and sets at 3.51 p.m., leaving only seven hours for the day distribution. In conclusion, thanks should be given to the author for the trouble he has taken in preparing the paper and for the valuable contribution he has given to the subject of extending and developing the use of gas for all purposes.

Mr. Thomas Glover (Norwich): I sent in my name as one who would like to contribute to this important discussion, because I have been studying the day-load question for quite a long time, and on former occasions have contributed to your proceedings some information on this matter. This is an instance of how the later speakers suffer, because Mr. Bell has said almost everything that I wanted to say, and has said it, no doubt, better than I could have done. He has spoken a word of appreciation of the paper, and the trouble that has been taken to tabulate and to present to the Institution the information in a way that we can appreciate and understand. I am sure we appreciate to the full the trouble the author has taken in preparing the paper, and the value of the information he has imparted by it. He sets out to investigate the day load question with the object of ascertaining the best means of increasing it. I am sure that is a most worthy object, and one which we should all do well to strive to attain. Though the diagrams and the tables do not give us very definite information on account of the overlapping of the lighting load between four and six o'clock in the evening and six and eight in the morning, because these spoil the diagrams to some extent for the winter months, yet they do nevertheless give us some very important information indeed. Mr. Bell has pointed out, I think, and the author also, that it may not necessarily be a healthy sign that we have a very high percentage day load. It may show that we have a low lighting load, and we have to fight for the lighting load. We do not wish to sell gas in any particular way; we want to sell gas. But, at the same time, a tremendous amount of progress has been made in cultivating the day load. The figures are very interesting; and the more we investigate them, the more interesting do they become. In my own case, I gave you three years ago some diagrams of day-load factors; and I have been referring to them again recently. But there is one figure which the author has not given you, and which I think is worth noting. I have taken out the day load in the summer months and in the winter months, not interfered with by the lighting—that is, on the shortest day I have taken it from 8 a.m. to 4 p.m. The average delivery of gas in my case was 81,000 cubic feet per hour; whereas taken over the daylight hours in the summer it was 55,000 cubic feet per hour. If we put it on diagrams, you will see, of course, that the percentage of day load in June and July would be perhaps 55 per cent., whereas in the winter the percentage day load would be very much lower if we eliminate the lighting. At the same time, I want you to remember that the output per hour was very much higher during the day in the winter than it was in the summer. This shows to me, and my diagrams show the same thing, that, when you get gas-cookers in, people use them in the winter as well as in the summer. That is a matter which is generally overlooked. When people have cookers, they do not depend upon it being hot weather; they go on using them, and the fires and heating appliances come into use in winter as well as the cookers, which helps to increase the output per hour, and swells it very considerably. Though I have shown that the winter day load is very much higher than the summer day load, I want also to point out—and I think it has already been mentioned—that the cultivation of the day load means levelling-up the summer load; and this goes towards keeping the plant and apparatus, and also the staff, better and more profitably employed right through the summer months than they would be if there were no cultivation of the day load, and if the day load were neglected. Upon the importance of the day load I am sure we are all agreed; but as to the means of cultivating it, there is yet a very wide field of work to open up. In my own case, we sometimes think we have almost reached the saturation-point in regard to gas-cookers. Out of a total number of 25,000 houses, we have supplied, in round figures, 20,000 cookers. The next point to attack, it seems to me, and we are attacking it successfully, is the question of water heating. More people are going in every year for bath-rooms, and the best way to supply a bath-room with hot water is by means of a gas-heated geyser. That is a point we are always driving into them, and with effect, because our morning day load—our before-breakfast day load—is constantly rising. Workshop and laundry appliances are also worth cultivating. And this, I think, is where the differential rate becomes expedient and is excusable. By bringing the price of gas down for special purposes, we can make it worth people's while to use it; and it is worth our while that they should use it, because our capital charges and working costs are thereby greatly

reduced. What do the electricians do? We are not on all-fours with the electrician, because he must have engines and generators equal to his "peak." We compensate for this by having cheap storage. I believe that we can advantageously reduce the price of gas for special purposes, and that we shall flourish by doing so. The electrician is willing to sell current at one-fifth his flat-rate for special purposes, the effect of which will be that we shall suffer if we do not do something also. He is willing to supply at one-fifth, and I think we could, with advantage, sell at one-half, or, at all events, we could offer considerable reductions for certain purposes, including laundry work, japanning, brazing and soldering, for iron-heating, and all the various purposes, according to the local conditions. There I am helping to justify the differential rate which I believe the author is in favour of for these purposes. I quite appreciate the object of the paper, and I hope it will do good to us all.

Mr. H. E. Bloor (Carlisle): I should like, first of all, if I may do so, to say that the author has introduced into the commercial side of the management of gas industries scientific methods of investigation—that is to say, he has made a definite effort to trace from the commercial policy pursued by different undertakings the result in the prosperity of their business, and the value to the profession of the methods adopted. While I say I think we owe a tribute to the author for having introduced this method of dealing with the subject, I do not agree with the basis upon which he has proceeded. He appears to have set up the relative day load as the criterion of comparison; and I do not think this is a fair or proper basis to proceed upon. It seems to me that, as gas engineers, our object is to sell gas, and it also seems to me that if we can set up an ideal case—say of a town where natural gas is obtainable at a very low price, and where practically the whole of the lighting, power, and other purposes for which fuel is required is done by gas—I say if such a town could be found, I do not think it is at all clear that the day-load factor, expressed as a proportion of the total load, would indicate the ideal condition which we should obviously regard that town as representing. We have not any such town, at any rate, in this country, though there may be something of the sort in the United States. But it occurred to me that the case of No. 7 in the Yorkshire section and No. 13 in the Lancashire section were not quite parallel, but were getting on in that direction. Now you will find that No. 7 in the Yorkshire section, in which the price is the lowest—viz., 1s. 4d. per 1000 cubic feet—is the highest, in point of consumption per head of the population; and that No. 13 in the Lancashire section, which is the lowest in point of price, is also the highest in point of consumption per head of the population. The comparison goes farther, because No. 13 in the Lancashire section is a lower price than No. 7 in the Yorkshire section, and it is also higher in point of consumption. On the other hand, No. 7 in the Yorkshire section is only seventh in average day load, and No. 13 in the Lancashire section is only thirteenth, whereas if you look at No. 4 in the Yorkshire section you will find that it is fourth in point of day load, and therefore would appear, by comparison, to be a well-managed undertaking, whereas it is five from the bottom in point of consumption per head, and No. 1 in proportion of day load in the Lancashire section is seventh from the bottom in point of consumption per head of population. So it seems to me that the basis on which the author should have proceeded, and the criterion for the comparison of management, should have been the consumption per head of population, and not the day load. Having arrived at this point, it occurred to me to consider what the day load, as such, represents to us. I appears to me that a high day load only affects, and can only affect, one item of expenditure, and that is the expenditure on gasholders; and seeing that the gasholder accommodation is fixed almost entirely with regard to storage and, generally speaking, the amount of gas required to balance the night load is left out of calculation, practically speaking the day load does not affect, I think, the capital cost of the gas-works. Now there is another point, and that is the question of the summer load and the winter load. I think that some of us run the risk of regarding the summer load as something which is intrinsically more valuable than the winter load. I do not know to what extent this affects the members of the profession; but in my own town I find that—shall I say?—a little knowledge is a dangerous thing. The administrators of the gas undertaking in my own city have arrived at the position that they know the summer load is a valuable thing; and in some way it has filtered through to them that the gas-cooker is a thing to be encouraged, and that stands as the summer load. Now mark the sequel. The day load is looked upon as something which may almost be handed over to the Electricity Department. This is the position in Carlisle, where the loss of the lighting load is quite cheerfully regarded, and I am told to console myself with the reflection that we are selling gas-cookers. It is poor consolation. I think Mr. Glover, who raised the question of the low lighting load, touched upon a very important point. It seems to me, in short, that we might, by those methods which would cultivate for us a heavy summer load and a heavy day load, be adopting the very best thing for cultivating a heavy lighting load as well. That is to say, if we allow the reputation of gas to languish, and permit it to be regarded as something which is not modern, something which is not going to be in existence in twenty years' time, something which is sloppy and dirty, then in that town we are going to lose a lot of our lighting load—not only the domestic lighting load, but also the industrial lighting load, which is so important to us. I have seen, in my own case, where an active canvass to interest a manufacturer in the use of gas for industrial purposes has resulted in his looking upon the use of gas for lighting purposes with a different eye than he had done previously. I was a little involved possibly in dealing with the cases Nos. 7 and 13; but the point is that the high consumption per unit of population, which is what we are all aiming at, does not necessarily accompany a high proportionate day load. I think if the author wished to introduce the question of the day-load factor as a criterion of successful management, and as something upon which he proposes to proceed in the management of his own undertaking, he might possibly have taken the actual day load per head of the population in the summer and winter months—that is to say, the actual figures. We have the actual consumption per head of population for the whole year. He might have taken the consumption per head of population for the six summer months as a criterion; but even then he would have had to add the absolute consumption in the winter months. He might have a very heavy consumption during the winter months as a reward for pursuing an advanced and progressive method in his business. The reward of a well-managed undertaking is a low price for gas; and the reward for a low price of gas comes right out in these figures of Mr. Townsend's. It is a high consumption per head of population. If any gentleman will take the consumption per head of population, and chart it against the price in the author's table, he will find a very marked comparison between the two. He will find, starting at the highest price of 3s. 5d., that he will get a broad band of dots on his diagram, and this band will progress till it comes down to Sheffield and Widnes. In this way the broad band he will get between his lowest and his highest probable consumption represents the local difference between towns. There is bound to be this local difference. Some towns with a high-priced gas have an exceptionally high consumption per head; but nevertheless they fall in with the scheme, and the diagram is a very instructive one indeed.

Mr. W. Whatmough (Heywood): I think there are one or two points that I should like to refer to. Mr. Townsend, in the opening statement of his paper, said he was pleased that he was emancipated from the absurd restriction of selling gas at one uniform price. I quite agree with his anxiety to be free from this restriction, but I cannot agree with his conclusions. In paragraph 5 of his conclusions he says, in his case, it is preferable to sell gas at a flat-rate. Though when he was compelled by Act of Parliament to do so, he referred to it as an absurdity, he is now willing to continue it. I think it is very desirable, in view of the competition we have, that we should sell gas at differential prices, and I should like to give some figures in my own case. For the last ten years the decrease in our consumption has been 8 per cent. for dwellings, 33 per cent. for mills, 9 per cent. in public lighting. We have a net increase of 9 per cent., though, if we had not cultivated the day load and charged differential prices we should have had a decrease. In view of the efforts which are being made to push gas-fires in the interest of smoke abatement, and especially considering the two recent exhibitions in London and Manchester, every encouragement ought to be given to consumers; and the only remedy is a low price which in most towns would necessitate a differential rate. Acting on this policy, my Committee some eighteen months ago decided to hire out

gas-fires at cheap rates—varying from 6d. to 1s. 6d. per quarter—for the winter months only, with all fixing free. We have had a clear twelve months' trial; and the system has justified its adoption. There is a net profit of 20 per cent. above the net cost of gas in the holders; so that there is ample margin for depreciation, returns, and upkeep.

The PRESIDENT: I feel that I must close the discussion at this stage, on account of what we have to follow, so that we may not have to crowd all the papers at the tail-end of our meeting, and dispose of them without being able to do full justice to them. Therefore I will now call upon Mr. Townsend to reply.

Mr. J. W. MORRISON (Sheffield): Might I suggest, Sir, that any further remarks which the members may wish to make might be sent in, and appear as an addition to the discussion. [A letter from the speaker, which came to hand later in the week, appears in the "Correspondence" columns of to-day's issue.]

The PRESIDENT: Yes. If any gentleman has any statement that would be of value, will he send it in to-day, if possible, so that it may be included in the public reports.

Mr. BLOOR: I wish to raise a question with regard to the curtailment of discussion. Might I ask when is the right time to do that?

The PRESIDENT: At the close of the meeting.

Mr. TOWNSEND: I am indebted to you, Mr. President, for saving me from having a long argument to discuss. In the first place, I will try and explain to Mr. Leather how it is that his very valuable statistics were not included. You cannot compare things that are not comparable, and therefore I had to rule-out all those which were not strictly in accord with the 6 a.m. to 6 p.m. day load. This ruled-out a considerable number, and I am afraid yours, Mr. Leather, was one of them. I have not your paper before me now, and therefore I cannot give any other explanation. I noticed that your day load is higher in winter than in summer, and that is what I stated in my paper was a great difficulty in getting the day load. No matter what hours you take, in industrial towns the day load will overlap the night load. I took 6 a.m. to 6 p.m. as the basis for my paper, because it is the time that has been taken by others, and it afforded the best way of bringing my figures into line with those of previous investigators. Mr. M'Lusky rather took me to task for undue caution. I always thought that caution lay more with Mr. M'Lusky's compatriots than with mine; but we seem to have changed places on this occasion. I think the chief point in Mr. Bell's remarks was as to why we had put up for so long with such obsolete legislation. Ten years ago we took the first step to appeal to Parliament to get liberated from it. But we were advised that our financial powers were so large that we could not go to Parliament until they were brought down to lower limits; so we had to postpone until this year obtaining freedom from the oppressive legislation that we have suffered from so long. Mr. Allen rather twitted me with putting Yorkshire in front of Lancashire. I simply did this because I am the Engineer of a Yorkshire Company. Of course, on looking at the charts you see that Lancashire is rather more of an industrial community than Yorkshire, as is evidenced by the number of groups of industries which are drawn attention to there. I must congratulate Mr. Glover very much on the splendid proportion of cookers which he has to the number of houses in his district. To have 20,000 cookers in 25,000 houses is an excellent proportion, and one which I think it would be very difficult to beat. We cannot show any such proportion as that in Wakefield. Mr. Glover also drew attention to the splendid field there was for heating water. I thought that I should have an excellent field for water heating in my district, and was very enthusiastic about it before the water-heaters came in. We started letting them out on hire at 1s. 6d. a quarter, fitting the houses up with both gas and water. We did all the work, and furnished the water-heaters to give a supply of hot water all over consumers' houses at this low rate. We fixed about six of them for a trial; but I am sorry to say they all came back again, one after the other, as the gas bills went in. The cost was so great that consumers sent them all back. Of course, this emphasizes the particular point that I tried to raise in my paper—that the relative value of gas and coal has a very great influence on the day-load question, and on the chance or otherwise of installing such appliances as these. Mr. Bloor, I am afraid, rather missed my point. I certainly did not intend to put these figures down as any criterion of the management of different undertakings. I started out with the object of seeing what was the best thing to do in my own case; and, of course, getting so many particulars, it became known that I was engaged in this matter, and I got dragged into reading this paper. My sole object was to see what was best for us to do in our own case, and I certainly had no intention whatever of making invidious comparisons between the working of any of my brother engineers.

Mr. BLOOR: May I explain that I did not mean that. I meant that you were starting out to free yourself from certain restrictions, and were intending to adopt what, from your own investigations, would prove to be the best methods in the future, and that you made your criterion the day load with the view of following the methods shown.

Mr. TOWNSEND: Of course, the whole object of the paper was to see how to increase the day load; and on going into the question I came to the conclusion (which was new to me till I investigated all the figures) that, while the day load was of very great importance, there was another matter which was of greater importance still, and that was the consumption per head of population. So that my point is the same as yours, and I make it in my paper, if you will kindly read it again. Mr. Whatmough and one or two other gentlemen who have taken part in the discussion have pointed out that my conclusions are rather at variance with one another. Perhaps you did not notice it when I was reading my paper, but I discovered that myself, and tried to correct it. My conclusion on point 3 is that it is wise to give substantial discounts for power and industrial purposes. Then paragraph 5 I read: "That, in view of the present trend of affairs, flat-rates in the author's case are preferable to differential prices, except in the case of power and industrial purposes." I am afraid you did not hear me read that; but I put it in. I am sorry that time does not allow of such a full discussion of this very important matter as I should have liked. To the best of my recollection, the question of day load has never been dealt with by the Institution hitherto. I do not ever remember it coming forward, and I had hoped that it would be so thoroughly threshed out that there would be no two opinions about it after the discussion had taken place. Time, unfortunately, will not allow us to have this full discussion; but I am very pleased to have heard the suggestion made by Mr. Morrison that any of you gentlemen who would like to add to the discussion should do so in writing.

The following remarks were handed in for publication by members who were unable to take part in the discussion.

Mr. J. H. BREARLEY (Longwood): The figures herewith show that the output from 6 a.m. to 6 p.m. has a tendency to increase at Longwood as compared with the remaining twelve hours of the day. They are chiefly useful as showing the importance of cultivating a business in domestic wash-boilers. Monday is the only day of the week upon which the daily output exceeds the nightly output; and the

LONGWOOD GAS COMPANY.

OUTPUT OF GAS ON DIFFERENT DAYS IN THE WEEK IN 1909.

Day.	6 a.m. to 6 p.m.	6 p.m. to 6 a.m.
	Per Cent.	Per Cent.
Monday	53·82	46·18
Tuesday	48·16	51·84
Wednesday	47·97	52·03
Thursday	46·53	53·47
Friday	45·98	54·02
Saturday	44·91	55·09
Sunday	44·40	55·60

OUTPUT OF GAS ON DIFFERENT DAYS IN THE WEEK IN 1911.

Day.	6 a.m. to 6 p.m.	6 p.m. to 6 a.m.
	Per Cent.	Per Cent.
Monday	54·80	45·20
Tuesday	47·96	52·04
Wednesday	48·80	51·20
Thursday	47·98	52·02
Friday	47·21	52·79
Saturday	47·68	52·32
Sunday	46·40	53·60

Total output from 6 a.m. to 6 p.m. (62,615,500 cubic feet) equals 49·01 per cent.

Total output from 6 p.m. to 6 a.m. (65,117,000 cubic feet) equals 50·99 per cent.

difference between Monday and the other days is quite marked. The Company hire out wash-boilers on easy terms; and though the maintenance charges on boilers are somewhat high, the policy has nevertheless resulted in a large increment of profitable business. The Company have at the present time on hire about 650 such boilers; and it is estimated that there are at least another 650 which have been provided by the owners of property for the use of tenants. The total boilers in use is approximately 25 per cent. of the number of consumers. Monday is the prevailing wash-day at Longwood; and the effect of consumption through domestic wash-boilers is shown by the percentage output on different days of the week for the year, which is as follows: Monday, 16·05 per cent.; Tuesday, 14·43 per cent.; Wednesday, 15·28 per cent.; Thursday, 15·16 per cent.; Friday, 15·28 per cent.; Saturday, 13·16 per cent.; Sunday, 10·64 per cent. It will thus be seen that Monday is easily the biggest day of the week. In 1911, there were 53 Sundays; so that in these percentages Sunday is favoured to the extent of about 0·25 per cent.

Mr. W. W. Townsend (Hereford): I quite agree with other speakers that the best figure for comparison is gas sold per head of the population; and a further column in the "Analyses of Gas Accounts" published annually to include these figures would be a useful addition. I should like to point out that we have been discussing two different things. The paper refers entirely to the percentage day load; while Mr. Bell and other speakers have emphasized the importance of the load factor—that is, the proportion of the maximum day load to the total yearly output. It has been well shown by Mr. Glover that the principal field now to be exploited which will improve the load factor is that of water heating; but, in my opinion, before any considerable progress can be made in this direction water-heaters will have to be so improved in construction, and cheapened in cost, that they will last as long, be as easily repaired, and as easily understood as the present standardized form of gas-cooker. They can then be let out on hire on easy terms. In my opinion, circulators, though they have a large field, are not the things we require, as thousands of houses have no circulating system. We want a cheap and lasting geyser, which can be hired out by the thousand.

Mr. R. W. Edwards (Aldershot): That the day load is largely a matter of locality and trade should, I think, read: That the extent of the day load is largely a matter of locality and trade. That the day load is an important proportion of a company's consumption cannot be disputed; and though the nature of this part of the load may vary according to the description of the town or district, my opinion is that, within a narrow percentage, the day-load curve can be made very similar in most places. Classifying the description of the areas under three heads, we get: (*a*) Residential. (*b*) Residential and industrial. (*c*) Industrial. In class (*a*), we get a predominating proportion of better-class consumers, made up with a good sprinkling of middle-class, lodging houses and apartments, and the small balance of working class, but no industrial purposes. In any of these, you can get a day load which will give a summer curve approaching 50 per cent. In class (*b*), the better description of consumer would be in the minority, made up with the remainder under class (*a*), *plus* (say) one-third industrial. Here, again, you get a day load which in summer would give a curve up to about 50 per cent.; the reason being that, while the better class of consumer is in the minority, therefore reducing the uses of gas for luxury—gas water-heating and afternoon entertainment, with intermittent use of gas-fires—the difference is balanced by the greater proportion of working class using gas for cooking breakfasts and midday dinners, *plus* continuous day use for industrial purposes. Class (*c*) would practically exclude any residential, such as form the greater percentage of class (*a*). But the day load would easily be made up by workmen's houses, and continuous industrial use. What, then, is the best way to treat these classes? Briefly, it is governed by the geographical position and size of the undertaking, and that it is well managed. If coal is dear, by reason of the remote position of the district from collieries, and the undertaking small, though well managed, then I fear you are unable to get into step with Widnes and Sheffield; and any price over 3s. should be treated with differential rates for cooking, heating, and engines. If coal is cheap and the undertaking of a size to permit good management getting the price down to 2s. per 1000 cubic feet or under, then I advocate flat-rates, with this proviso: If the district comes under class (*a*), all flat-rate. If under (*b*) or (*c*), flat-rate, except for industrial purposes, and then, with discount, bring the price down to the region of 1s. for suitable annual consumption. If the price can be brought down to 1s. 6d., then I say there should be one common flat-rate all round—excepting to very large consumers of at least 5 million to 10 million cubic feet per annum, and then not to bring the price below the net of 1s. per 1000 cubic feet, which will, in my opinion, compete with any other form of power, taking into consideration the saving in capital, standing, and working charges. The conclusion of my argument is: Where your undertaking will permit, be continually bringing your plant up to modern lines, and produce and sell at the lowest cost. I am satisfied that gas at 2s. 6d. will yield a higher average per *capita* than even 2s. 9d. But to get to 2s. or 1s. 6d. is the aim; for unless these figures are in operation, there is little hope of getting gas-fires for constant use, as fires fixed in rooms requiring only intermittent use are not remunerative, especially with the mild winters of recent years.

Mr. A. E. Mottram (Ossett): As I am Mr. Townsend's next-door neighbour, he will no doubt expect me to pat him on the back; and I have very much pleasure in doing so. He has undoubtedly worked with his well-known energy to get all these particulars together in such an instructive form. When I heard the first half-dozen lines of the paper, I was delighted, because I thought he had become converted to a liberal discount system; and I accordingly expected to hear a paper in favour. He states he has been handicapped for many years by being compelled by his old Act of Parliament to charge an equal rate for gas for all purposes; and wishing to get emancipation from this absurd restriction, he has been to Parliament this year for a new Act. In view of this strong statement, and after hearing the particulars that he has got together in his paper, I cannot understand how, in Conclusion No. 5, he says: "That, in view of the present trend of affairs, flat rates in the author's case are preferable to differential prices." Then, in Conclusion No. 6 he says: "That it is better in the author's case to reduce the price of gas all round as much as possible, in preference to giving discounts." Well, in reply to this, I think if he would adopt a liberal discount scale he would very much sooner be in a position to make an all-round reduction in the price of gas. His district joins up to mine; and I have for years given discounts with very satisfactory results. For a consumption of 20,000 to 50,000 cubic feet per quarter, we allow 5 per cent. discount if the account is paid within one month; between 50,000 and 100,000 cubic feet, 7½ per cent.; over 100,000 cubic feet, 10 per cent.; and for all gas used for cooking, gas-engines, and industrial purposes 25 per cent. Our total consumption has doubled in ten years, the consumption by gas-engines is five times more, and by cookers nine times more, the price for gas has been reduced 6d. all round, and standing charges have been reduced 8d.—the 2d. difference between the two having been spent in heavy repairs and renewal of works and plant. Our cooker consumers use three times more gas on the average than our ordinary lighting consumers, and our gas-engine consumers twenty times more; and most of this is day load. I notice from tables given in the paper that my average day-load is rather better than his. This is no doubt due to the absurd restrictions of his old Act of Parliament. The author points out that active electric competition, &c., decreases the night load, and so increases the percentage day load. I believe that he has very strong competition, and so his day load apparently benefits; whereas my case is just the opposite, as we have only 47 houses that do not use gas within the reach of our 50 miles of mains. So my night load is the heaviest possible, which consequently decreases my percentage day load. I find the greatest drawback to further increasing the cooker day load is the difficulty of finding room in the small kitchens for a cooker; and I think it would be a mutual advantage if we could draw the architects, builders, and fire and cooker range makers together with a view to making better use of the space taken up by the present somewhat clumsy fire-ranges. I should like to ask Mr. Townsend, in replying to the discussion, to say whether he is not prepared to modify his Conclusions Nos. 5 and 6, when he considers that he has throughout the paper spoken in favour of discounts, and in view of the fact stated, and when he remembers the public are very fond of receiving discount, and are very good at being led in the way they want to go, which in this case is to their and our advantage.

Mr. H. Kendrick (Stretford): The information contained

in the paper is capable of being made exceedingly useful when properly studied. It shows us what to imitate, and what to avoid. For instance, the vain striving after the fancy differential prices practised by electricians is shown by Charts 12A and 12B to have been of no more benefit than the flat-rates in other districts—in fact, the advantage is with the opponents of flat-rates, though it is possible that the consumption might have been lost to the particular departments enumerated had not the differential scales been adopted. In such cases, the special rate for certain special customers would be justified. It is exceedingly doubtful if extreme differential prices can be given generally without the other consumers having to pay an enhanced price, as in the various schemes that have been put forward from time to time it has been assumed that all the distribution and office charges should, in strict equity, be divided *pro ratâ* over all consumers, not over the make. This is, I think, a wrong premiss, as a considerable part of the office expenditure is truly a manufacturing charge solely, and a large portion of the distribution charges are for the benefit of the undertaking as a whole, not for individuals, and must be subdivided over the make, not the consumers. If the expenses are divided by the extremists subject to these two amendments, the extreme variations will disappear, and the charge for gas will work out more evenly, as those do by a larger section of the undertakings who have two scales of charge (lighting, cooking, heating and power, and industrial), and allow special discounts from these for quantities. I am in agreement with the author when he states that the extra services now given in free appliances, free cleaning, and free maintenance have to a large extent destroyed the argument in favour of a differential price for cooking, as any saving effected here by keeping the manufacturing plant working during the slack season is entirely wiped out by the cost of the extra services which are now demanded and given by the majority of gas undertakings. As for differential price for heating, I have never been able to see the justice of it. The greatest demand is always when the works are on full stretch, and always helps to increase the winter peak load, not to level it up. There is, however, a compensation, as so many fires are used in the late autumn and early spring, and so help to prolong the season of maximum demand. It is, in my opinion, much better to offer facilities for hire, hire-purchase, or free fixing, instead of reducing the price of the gas specially for these purposes. Both clearly cannot be done in strict justice to the remaining consumers. The general body of consumers, when speaking of the price charged for gas, always quote the highest figure without any reference to the rebate or discount; so that the department rarely in comparisons gets the credit it is entitled to, either in comparison with neighbouring towns or with electrical costs. For this reason alone, a flat-rate, with special rebates or discounts for special industrial concerns or specially large consumers, is preferable. Again, the long-hour loads are not those of cooking, but the industrial and power loads, which require gas for at least 50 hours per week, as compared with 10 or 12 hours for cooking; while as compared with the heating load, the industrial load is 50 weeks a year, against 16 to 20 weeks at the most for heating. So that the industrial consumers are those only who are entitled to preferential treatment if any are entitled at all. There are a few criticisms I should like to pass on the deduction from the charts. I do not think that the day load, as shown by Charts 1A and 1B, make out a general case that local industries are the cause of a high day load, as there are many instances when a high day load has been worked up without this aid. Take my own district. The day load went up from 20 per cent. to 32 per cent. by the aid of industrial gas, and from 32 per cent. to 42 per cent. by the aid of free appliances; while during the past six months, owing to the activities of our electrical friends and the taking over of the street lighting by our electrical power-owning local authorities, the day load had apparently increased 5 per cent., while the night load had actually decreased 1 per cent.—the actual increase being only 1½ per cent. on both. The nearness of the coalfields undoubtedly has an effect on gas sold for heating and cooking. This is felt in South-East Lancashire as well as the West Riding of Yorkshire; and the fact that so many undertakings in these districts sell over 40 per cent. of their gas during daylight shows how active all those in charge are in the interests of their undertakings. As to the falling of the day load in the spring as compared with the autumn, this is caused by the more rapidly falling of the heating load in the spring and the non-overlapping of the heating and cooking loads; while with the chills of autumn evenings and hot days, both sources of gas consumption overlap during September and October. Chart No. 4 also shows that manufacturing towns have a greater consumption per head than residential areas. This naturally affects the consumption per mile of main, the unaccounted-for gas, and the pressures necessary to work the district. All these naturally affect costs, and have to be allowed for; so that it does not always mean that the undertaking which sells at the lowest price is doing the best for its customers—one charging a considerably higher price may be doing equally as well because of its environment and circumstances. While the reverse is in many instances also true, there are towns supplying at a high figure which ought to charge a much lower one. Many more similar matters can be learned from these charts; but I will conclude by thanking Mr. Townsend for so ably collating and tabulating the information from which so much can be learned.

HIGH-PRESSURE GAS FOR MANUFACTURING PURPOSES.

By A. W. ONSLOW, of London.

The foundation of this paper was laid eight years ago; and if it is not replete with statistics such as are usual in an Institution paper, the omission is one over which it was impossible for the writer, as a public servant, to exercise control. The results built up were far beyond what one dared to expect; the drawback being that, although the practical value of the work was shown, there were many able, but none willing, to assist him in carrying the results to their final completion. It was therefore particularly interesting to him when a branch for research work in heating was started by the Birmingham Corporation Gas Department in connection with high-pressure gas.

The Question of Proper Design.

It was an easy matter to design gas-furnaces—to achieve a certain object; but the detail work needed co-operation by others to continue it. A designer of such plant, and who administers to its maintenance, must necessarily aim at perfection in simplicity as well as efficiency. Many may well ask why a man already occupied with the management of a gas-works of about 300 million cubic feet per annum, which included an extensive system of lighting, should attempt the work of revolutionizing heating? He would reply that, having gone satisfactorily through such difficulties as a gas stokers' strike, the supply of gas during the South African War, and then placing the lighting beyond the pale of competition, his thoughts were turned to heating, as little by little, various idiosyncrasies were disclosed which seemed to be quite opposed to satisfactory gaseous combustion. Confronted with many such examples, the writer ventured into the work with a light heart; but has now to regret that the labour and sacrifice of eight years have not resulted in the manner he had hoped.

It was necessary, in order to arrive at a basis of comparison, to obtain information from every possible source as to the various methods in use. In the collection of this, the writer was indebted to many members of the Institution for communicating to him their difficulties and problems. The correspondence extended to many countries—in fact, no effort was spared to obtain material for exhaustive investigation. The results were most interesting, seeing that in no two instances were the same methods of heating used; and each problem had to be carefully thought out. In considering improvements, it was determined to reverse the old methods as much as possible, not necessarily accepting the principles previously laid down. The difficulties involved will be obvious. In the first place, how could an unskilled workman be expected to mix air and gas properly with fluctuating pressures in both cases. Cold air was not restricted on a defined basis, and air was also allowed to pass into the heating-chamber in such quantities as to render the the system most uneconomical.

Faulty Design.

Take, as an illustration, the old form of japanning oven, open all round at the bottom—in some cases as much as 4 inches. The value of fire-clay as a conductor was not sufficiently taken advantage of. There was waste through radiation; and in many instances the methods of heating

were extremely crude. Machines were designed otherwise perfect in scientific detail; the gaseous portion appearing to be the very last consideration. In passing one might say that the larger consumers, or possible consumers, of gas for manufacturing purposes are supplied with apparatus not made by the regular gas-furnace makers. A battery of such furnaces brought to the writer's notice must have lost enormous sums of money in labour and material before coal displaced gas. And even to-day, certain apparatus requiring gas as the heating agent may be found designed by highly-skilled mechanical engineers, in the heating portion of which it was questionable whether a gas engineer ever had a hand. The writer has in mind such a piece of plant, in the design of which, had a gas-heating engineer collaborated, success might have resulted satisfactory to the gas industry and to the consumer. Certainly the quantity per hour it is designed to consume will place gas out of the running; whereas a reduction of 50 per cent. was possible in the apparatus when correctly designed. But who would go to the expense of altering the apparatus after delivery? Certainly not the purchaser if he could help it, especially when he compared the cost of working one furnace with solid fuel against the other heated by gas. It is a pleasure to be able to say that the Gaslight and Coke Company, who are dealing with this question in a favourable manner, are being met by the makers in a friendly spirit.

In starting, therefore, it was the writer's intention, no matter what the effort involved might be, in every instance to do the work on the lowest possible consumption of gas. With this object in view must the adoption of gas for commercial purposes be considered. In one instance, economy was effected in a whole undertaking to the extent of 50 per cent.; the working results being quite satisfactory. In this case, not only the consumer and the gas industry benefited, but the country as well, as it meant a cheapening of the articles manufactured; and eventually led to consumption again reaching its normal state, and making gas indispensable.

The Gas and Air Mixtures.

The first problem dealt with was the bad mixtures of air and gas. Frequently, the question of "How is your furnace working to-day?" was answered by "We cannot obtain the required temperature under four hours to-day, as against two hours yesterday; the gas must be bad." But really the reason was that the workmen could not mix the air and gas properly, and explosions frequently occurred, disastrous to man and furnace. It was strange to see an eight-burner gas-furnace with air under pressure; the workman adjusting each burner in rotation and then coming back to the first one to begin the process again if the air or gas pressures changed. It was therefore quite a common thing to find two only of the eight burners with a correct mixture. And how was it possible for a working man to be expected to arrive at a correct temperature under such conditions? It was then that the writer came to the conclusion that gas must be maintained at a constant pressure; air drawn in under atmospheric conditions; that by regulating these sources definite results could be obtained; and if the work were conducted under known tabulated conditions and requirements, certain results could be promised and maintained. It was anticipated that, at a time not far distant, under all circumstances of whatever description, the works manager or scientist would be able to control the conditions of work without the aid of the skilled workman, who would be told merely to see to the pressure and wait for a definite period, counted in minutes, for the result to be obtained. If necessary, each week the furnace could be calibrated, and the work continued in such a way as to ensure its continuance under ideal conditions.

In the old furnaces, the conductivity of fire-clay did not seem to be sufficiently taken into consideration. Consequently the combustion chambers were very big, and the flame had to travel over large areas before getting to effective work. The earliest design for (say) a case-hardening furnace was to reduce the size of the combustion chamber, compel the flame to at once strike fire-clay, and, by restricting the air supply, a uniformity of temperature was obtainable. Thus the table H (fig. 1) was quickly heated and maintained equally for hours at a stretch.

The flame from the burner passed through a hole at A, striking the floor B; the distance from B to C being regulated by the width of the furnace, as the flame was compelled to travel to the baffle E. This form of furnace required more burners than one, throwing the flame from F to G in fig. 2.

Each burner had its own definite work to do on each side of the baffle E. So constant is the temperature, that the record by an iridium platinum pyrometer for thirty-six hours showed a variation of less than 2° C. up or down. It is an

Fig. 1.

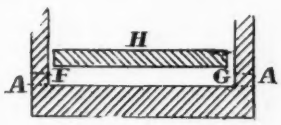


Fig. 2.

easy matter to obtain 2000° to 2500° Fahr. in this furnace on the table H in a known length of time by the simple method of determining both the pressure of the gas and the position of the burners.

Had the question of a suitable refractory material been dealt with, the employment of nodules of such material between B and C in fig. 1 would have been continued; but the material fused, and its use was abandoned. The space was reduced for combustion only so as to ensure immediate flame-contact.

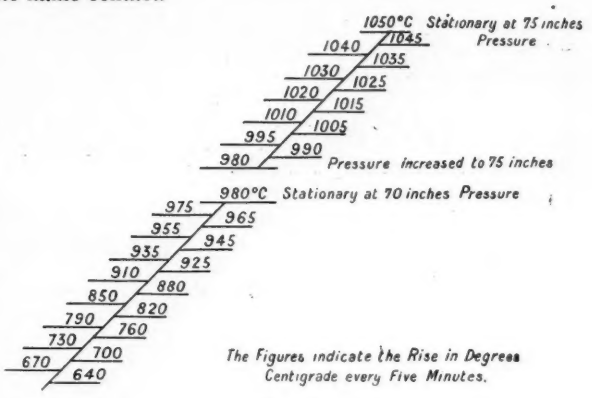


Fig. 3.

Fig. 3 shows the rise in temperature in a furnace at intervals of five minutes. A constant line was obtainable at any point. The process appears slow; but the stated temperatures could have been obtained in a shorter time than indicated by simply raising the pressure until the limit was arrived at, and then leaving the pressure so that it was possible to obtain (say) 1600° Fahr. in 35 minutes, and save delaying the workmen.

Construction of Furnaces for Special Work.

If a record were given of the various types of furnaces heard of and seen, it would not be of any great practical value, as the motto is "progress." But one specially glaring instance of a badly designed furnace may be mentioned, in which the variation in temperature was about 600° Fahr. between one end and the other; and the conversations that took place over the losses in hardening, tempering, &c., were very interesting.

Furnaces had been in use having dimensions 6 ft. by 4 ft. by 2 ft. for heating articles that needed a space of only 2 ft. by 1 ft. by 1 ft. In this case, a bricklayer built up a smaller furnace in a few hours, which was as efficient in action as a permanent one, and could be removed or pulled down when done with. In this way, bar steel, angle, or channel irons, could be heated for any purpose; the furnaces being built in a few hours and rebuilt to suit all requirements. To take, as an illustration, ½-inch bar steel. Some 2000 bars could be heated and rolled in a fortnight, and the furnace altered for 2-inch bars—a slight modification only being desirable. The furnace for angle and channel irons would be somewhat different, but alterable in half a day by a competent bricklayer.

Bar steel can be worked in a continuous line, averaging 60 seconds per inch in thickness of metal, allowing this ratio up to 2 inches in thickness. But beyond this size, 50 per cent. longer time is desirable for soaking purposes. Refractory material must be prominent in every position, with sheet asbestos lagging; so that it is quite possible, with a few fire-bricks, fire-clay, burners, and lagging that a dozen different

designs can be built up with the same bricks and tiles, giving satisfactory results.

For railway engine wheels, axles, &c., furnaces can be built in the same way. It is recommended, however, that the furnace be made to the size of the wheel or axle, with fire-clay inside the bottom, sides, and lid; the latter having a flue outlet and lifting hooks. Four wheels at a time have been thus dealt with—four axles heated vertically in 30 minutes, 5 minutes being allowed for "soaking," and the temperature regulated by a stop cock and the use of a pressure-gauge.

To emphasize the value of fire-clay, the usual hot plate for warming purposes, consisting of a flat steel or cast-iron plate having a row of burners underneath it, is, for commercial purposes, a wasteful system, as it heats the atmosphere more than the plate. In this instance, the plate was boxed-in with the sides and bottom of sheet iron, forming a rectangular box 6 inches high inside. By placing four burners

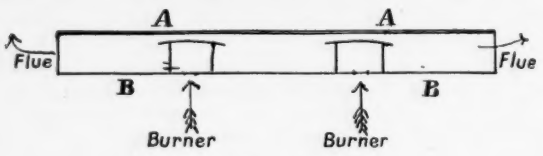


Fig. 4.

as shown in fig. 4, the flame was made to play on to an iron baffle, so as to prevent the heat being in patches. Good results were thereby obtained—the temperature at A becoming 110° Fahr. and 65° Fahr. at B; but by substituting a fire-clay tile as a baffle (fig. 5), the temperature at A became 200° Fahr. and at B 165° Fahr., with the same quantity of gas and in the same length of time.

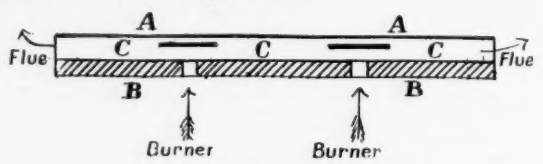


Fig. 5.

As comparisons were being made with heating by coal, a further economy was sought for; and with this object in view, the floor inside was covered with fire-bricks laid flat, as shown at C (fig. 5), leaving 3¾ inches clear between them and the baffle-tiles. The result was so effectual as to warrant the shutting-down of two out of the four burners during two-thirds of the day. If the temperature at A is to be higher than at B, the baffle is raised; and it is lowered if B requires more heat.

In the case of printers' type drying, a cupboard placed under the hot-plate at B gives such a satisfactory and economical result that no ground is left for the question of using solid fuel for raising steam to do the work. A height of 3 inches is quite sufficient as a combustion space, taking also the waste heat from type or other melting pots. This method is applicable to ovens such as japanning, foundry drying ovens, &c.; and the illustration given of its principle may therefore suffice for many purposes, without entering into details of the various ovens that can be heated in this way. For lead or printers' type metal, a fire-clay lining is used with gas at 65 inches pressure, as supplied in the foundry for lighting. The flame passes from A to B (fig. 6) and back to C, passing out of the flue running round the pot at D, and into the main flue E. In the first instance, the temperature was so local as to have a chilling effect on the top portion of metal when the pot was full. The flue being already built, it became necessary to modify the heating chamber accordingly; but when building new furnaces, the flue E should be above, or on the level with, the top of the metal when the pot is full, as a large flue is quite unnecessary. This will give a better effect in the combustion chamber. The flue and combustion chamber should have a space not exceeding 1 inch from the side of the pot to the fire-clay up to one-ton pots, and 1¼ inches up to 8 tons; and it would be preferable to raise the height of the flue inside rather than extend its width.

Superiority of Gaseous Fuel over Coal.

By the above method of heating, taking labour and waste into consideration, gas was found to cost less than coal. This particular type metal pot one-third full was melted by three burners in 30 minutes; two-thirds full in 45 minutes; and full in 70 minutes, or 60 minutes with a smaller flue. The furnace is provided with four burners; but three only are used—the fourth being available if desired. The consumption of gas per burner is 80 cubic feet per hour for a 15-cwt. pot; and one burner suffices for the remainder of the day. A one-ton pot has four burners, with a 100 feet burner to maintain the heat. Three of the four burners are used for the first melt, and one afterwards; and two burners, 40 feet per hour each, for a 5-cwt. pot. To melt these pots by coal would occupy 2½ hours. The type foundry is now, however, ready for work in half-an-hour; and this time could be reduced if desired. As the combustion chamber at the bottom is of fire-clay, the accumulated heat is absorbed by it and stored. This system has given the greatest satisfaction, and no difficulty is experienced.

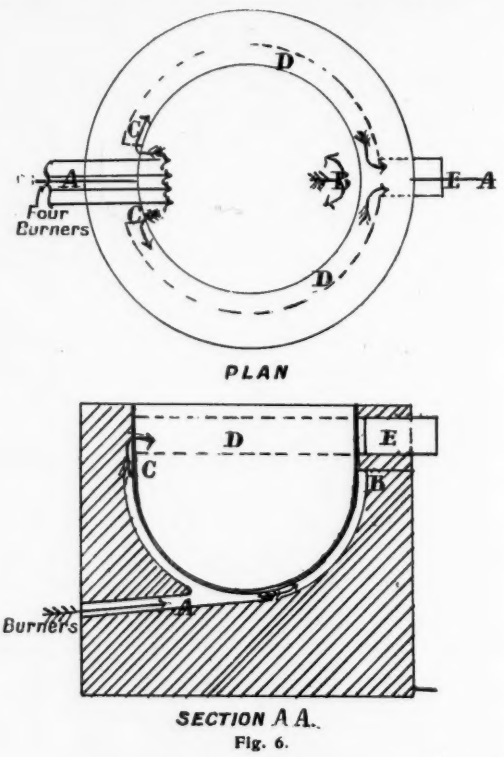


Fig. 6.

Future furnaces will have fire-clay close to the cast iron, especially if great rapidity of melting is essential, as the heating is not local, but occurs through a gradual warming through of the silica tile. The impinging of flames directly against the cast iron has, in the writer's opinion, a tendency to fracture the metal. The high-pressure gas needs only the tap to each burner for turning on or off the supply; the burners lighting-up automatically from the red-hot fire-clay, which is purposely left in a jagged or rough state. In the case of the tile being close to the cast iron, it is supported by silica pillars, which transmit the heat also to the tile above.

Experience has shown that, with gas at 2s. per 1000 cubic feet and coal at 20s. a ton at the furnace, there is very little difference in the cost of the two methods of heating; that the difference is in favour of gas, when used for practically all commercial purposes, provided the gas-furnaces are designed with a view to the greatest economy. But there are instances where gas is infinitely cheaper, cleaner, and more suitable in every way. The exception is with large furnaces when immediate contact of flame with refractory material is difficult.

Aluminium, brass, copper, &c., melting having been exhaustively dealt with in former papers read by Mr. E. W. Smith, of the Birmingham Corporation Gas Department, it is only necessary to add here that a practical application, bears out his statements. When the furnaces are built by the gas companies' men, care must be taken to see that the surface of the interior is smooth, with fine joints in the brickwork to ensure the easy flow of gas round the crucible. This, of course, only applies in the case of crucible or other furnaces supplied with one burner at the base depending upon the length of flame to complete the work. The writer is, however, in favour of more burners with limited area, and

the furnace provided with obstruction to break up the flame and leave little space before the flame comes in contact with the refractory material. Emphasis should, however, be laid on the need for suitable lagging, even with 9 inches of brickwork.

In determining the method of heating, there are numerous instances where high-pressure gas is unnecessary; but in some cases before the writer, as provided by a batch of 115 furnaces, and about 250 burners, it is obvious that a single workman could not adjust air and gas supplies satisfactorily, especially when dealing with progressive temperature from 400° to 2000° Fahr. All the furnaces are to be lit up simultaneously, and shut down at the same hour after working continuously for a day and a night. It is therefore necessary, in order to carry such work to a satisfactory end, that great care and thought must be given to the perfecting of a system that will leave nothing to chance or the omission of a workman; and it is the author's aim to tabulate any temperature so that a diagram of pressure registers gives the result of the day and night's work accurately to the manager, and for the cause to be explained if any defect arises.

If high-pressure gas needed instances to justify its existence, one or two only might serve the purpose—viz., its application in the operations of shrinking or unshrinking on of coils or large tubes, when, by pumping gas against the steel, the labour formerly occupying weeks can be got over in an hour.

High-pressure gas is positive in its action, as exemplified by a certainty in shrinking which occupies now only eleven minutes against a problematical twenty-five minutes before its adoption. The time lost by workmen, the uncertainty of the work being properly done, and the cost of doing the work over again, are so great that the saving would be interesting to ascertain. But with gas at 60 inches pressure, the time can be gauged accurately.

The writer cannot understand large engineering works not having a high-pressure gas plant—portable, if necessary—for dealing with difficulties as they arise, whether it be for hardening steel shells, annealing tubes, case-hardening armour plates, bending angle irons, crank shafts, or the multifarious work of a ship-building or any engineering works, especially when advice can be obtained from the gas companies at all times.

Ideal Workshop Lighted and Heated by High-Pressure Gas.

The following outline of an ideal workshop lighted and heated by high-pressure gas may be useful: A single pipe running round the shop; the initial pressure of gas being (say) 200 inches, with either a governor or valve with pressure dial for each furnace in use—the various pressures to be previously determined by the shop manager. The following are some of the pressures necessary for various kinds of works: Melting tin or solder, a pressure of 65 inches; for small furnaces for heating tools for hardening purposes, 65 inches pressure is sufficient. In some workshops, several of such small appliances are in use. All that is required is a small square box, lined with fire-clay, provided with one or two burners.

In furnaces for blueing steel (65 to 80 inches pressure), the lime tray is set in a fire-brick frame, with burners playing underneath at a tangent. For case-hardening furnaces, 65 inches is the pressure; lead-pot for tempering steel, 150 inches pressure; melting metals at 2000° to 2600° Fahr., 200 inches. Soldering irons require 65 inches pressure. In this case, two burners, consuming 6 feet of gas per hour, with the flame playing on the soldering iron—not in this instance radiated heat from fire-clay, although the furnace is built with refractory material—are sufficient. Two such burners suffice for ordinary irons; and it is found possible to heat irons for a workman without stoppage.

For lighting, 65 inches pressure is required, or according to the system adopted. No two instances have so far been presented where identical designs were applicable, whether it be for melting solids, such as sugar or varnish, or dealing with zinc, mercury, or other compounds, each requiring distinctive treatment. The subject would appear to be of much more concern to gas undertakings than to furnace makers, as the material to be supplied for construction is of little importance to the latter, whereas the resulting consumption of gas may run into millions of cubic feet per annum.

Compressing Gas.

There is need for a cheap and efficient means of compressing gas up to 15 lbs. per square inch, as a manufacturer considers the first cost very seriously; and if the adoption of gas under pressure is to become universal, some attention to this branch of the subject is desirable. Burners, the building-up of furnaces, loss by radiation, air supplies, &c., have all been satisfactorily dealt with; so that the compressor is now apparently the last factor needing settlement. The fact must be kept in view that, if air is to be admitted under pressure, it must be continuous. In an instance under the writer's knowledge, with one furnace the air pressure was 3 lbs. per square inch; but with two furnaces at work, the pressure dropped to 2 lbs. per square inch—no two days' results being alike. Some understanding between the consumer and the gas companies' representative might have averted this.

The Type of Burner.

Up to the present, the writer has worked upon no fixed principle of determining what the pressure of gas must be against air under pressure; but he has not had an instance yet where gas at 15 lbs. pressure is not equal to air at 5 lbs. per square inch. There is a rule to be fixed; but the difficulty is due to the relative size of the air-duct with gas under pressure. This size is determined in the "Smith-Walter" burner for the quantity of gas, and also in the burner designed by the writer not only to prevent the objectionable noise of a high-pressure burner, but to provide a mixing-chamber before combustion takes place. The drawback is, that it was possible, under certain conditions, for the burner to light-back unless secondary air is admitted. When secondary air is admitted, then it is satisfactory. The secondary air can be superheated. Lighting-back can also be obviated by regulating the distance between the end of the burner and the furnace. It is preferable not to provide a flue-damper only in exceptional cases; and if one exists to have it made a fixture. Chimney head is unnecessary with high-pressure gas unless a due proportion of air cannot be admitted at the burner. In deciding upon a method of heating, one may have some doubt whether a rotating flame or a straight one is desirable. But in cases of temperature requiring an increasing force (from 400° Fahr. upwards), the straight flame (fig. 6) is favoured. For a continuous temperature, the rotating flame round the base or side of a vessel is probably more suitable. For varnish making or similar furnaces—especially with vessels with flat bottoms—the method shown at fig. 6 is favoured. If the vessel is large, small burners placed at intervals are used; but if apparatus like fig. 6 can be worked upon, the combustion chamber is limited from ¾-inch to ½-inch, and obstructions placed therein.

It must be candidly confessed that, given a fair and open trial of gas under pressure, it is as economical as air under pressure, and infinitely more satisfactory for continued usage or spasmodic lighting, extinguishing, or progressive temperatures; its charm being simplicity and ease of control.

The present paper would be incomplete if no reference were made to the necessity of the gas engineer having some knowledge of general engineering work, as there are times when, in considering a change in methods of heating, a complete alteration of manufacture presents itself; and he should be able to specify and prepare the work from first to last, so as to be able to advise and bring to notice the latest invention, and give to a consumer the benefit of an up-to-date plant in every respect.

Discussion.

Mr. W. H. Y. Webber (London): I rise to say what a very high appreciation I have, I am sure in common with everyone who is interested in the extended use of gas, of the remarkably practical success of Mr. Onslow's grappling with this difficult matter. In listening to his paper, it has struck me that he might have left a little room for misapprehension in the earlier part, where he speaks about the difficulty of the workmen adjusting proportions of air and gas. I do not think it was made quite clear that Mr. Onslow was referring to producer gas in that connection. I fancy, from what I know of his work at Woolwich Arsenal, that he thought everyone would perhaps understand that he was struggling with producer-gas plants installed there for doing various heating and tempering work before he undertook to adapt the ordinary coal gas to these purposes. There can be no question that putting ordinary town gas under pressure gives the worker absolute control of the result. It is extremely interesting also to

notice that in Mr. Onslow's work he has always proceeded on the principle of bringing the gas and the furnace, if it is worth calling a furnace, to the job, instead of taking the job to an already made and fixed furnace. There is a wonderful difference in that. If it is a question of applying local heat, for instance, to a heavy crank-shaft lying on the ground, instead of going to the expense of dragging the shaft to the workshop, and putting it into somebody's patent furnace, he has simply started with a few bricks and fire-clay and high-pressure gas, and has put a furnace round the particular place it was required to heat; and in some cases he will have finished the job before it would have been started in the other case. This has struck me throughout as being a valuable characteristic of all Mr. Onslow's work. There is no doubt an enormous future for the application of high-pressure gas for heating; and I think that due credit should always be given to Mr. Onslow as a pioneer in this work, because he was at it long before other people thought of its possibility. I do not know really that there is anything I can add to the remarkably useful hints that Mr. Onslow has brought before the Institution. I can only, in conclusion, put upon record, as I said just now, my own warm admiration for his talent in this direction.

Mr. J. P. Leather (Burnley): I think that we are all indebted to Mr. Webber for the explanation he has given of some portion of the paper. I had no idea in reading the paper that there was any reference to producer gas in the early portion. There is no doubt the paper shows that Mr. Onslow has done a great deal in bringing commonsense to bear upon the application of gas to a great many purposes. I think that is a condensation, if I may so express it, of about one-half or three-fourths of the paper. In applying gas, it wants somebody to exercise a little commonsense in the way it is done; and in his paper he has given several hints as to the bearing of this fact. I do not think it must be taken that high-pressure gas is, under all circumstances, absolutely necessary. Where high-pressure gas, as Mr. Onslow suggests in his paper, becomes the regular thing, so that people can have it laid on, as, of course, may possibly be the case before very long in some districts, it will have its advantages; but when it comes to the question of a firm, not on the large scale that Mr. Onslow has had to deal with, having to compress its own gas, it is doubtful whether after all pressure of air may not be a more commonsense procedure. Mr. Onslow has stated very clearly that the comparison between high-pressure gas and high-pressure air is a question of much higher pressure in the one case with a smaller volume, against a lower pressure with a higher volume. I should like to add that I have given some consideration to the question of the application of gas to industrial purposes. I had a little to do with the designing of furnaces of a variety of types; and I had the thought in my own mind some time ago that after all pressure is nothing. Why should we want any pressure at all? Cannot we do without it? I almost undertook to design a burner which, if it had been a success, would have been used at the Royal Mint for the melting of the various metals from which our coins are made. In that I was not going to have any high-pressure gas or any high-pressure air either. I have to confess that I did not succeed. The point that has to be aimed at in this matter is that in the first place you must have an efficient mixture of air and gas. I do not know whether the meaning of the words, which, no doubt, Mr. Onslow understands, is taken in by everybody. I do not mean the mere mixing of the right volume of air with the right volume of gas, but it should be very thoroughly and intimately mixed; and the meaning of this does not really properly get into people's minds until they have had a little experience in doing it. If you do not have intimate mixtures, you do not get the shortness of flame which means high temperature. Of course, I am thinking of fairly high-temperature furnaces. Mr. Onslow has dealt with a great variety of furnaces, but I am referring to high temperatures such as are required for the melting of metals—particularly when you get such a thing as the melting of nickel. We must have an intimate mixture, so that you should be able to take a cubic millimetre of the mixture—and perhaps even a smaller volume than that—and every cubic millimetre should have its proper proportion of gas and air in it. The difficulty is that if you do not have some pressure, either of gas or air, you cannot get this intimate mixture, and, what is more, if you do try to get it without sufficient pressure, you will not have sufficient velocity to prevent lighting-back. I may say that my experience of the lighting-back of burners is that, taking the average velocity of the mixture in the tube, the lighting-back occurs at a much higher velocity than that which is generally assumed in the text-books on the subject. I think this is practically all I have to say as a contribution to the discussion. I think that there are many cases in which the simplicity of the machine which will compress air to 2 lbs. pressure (which is sufficient for most cases) recommends it. Compressing gas is a very different thing from compressing air, because you must not have a leakage of gas, but some leakage of air does not matter. Compressing gas to 15 lbs. pressure may all too often be a considerable objection to high-pressure gas, whereas it is very easy to have a fan or Root's blower for compressing air to 2 lbs. and you get results that are quite satisfactory. I wish to express my appreciation of Mr. Onslow's work in the matter, which I think that all of us will thoroughly understand.

Mr. R. W. Edwards (Aldershot): With regard to the proposition of the use of high-pressure gas as fuel, I should like to put to Mr. Onslow one or two points. First, with respect to the transmission at 15 lbs. pressure, does he raise the gas to this high pressure at the point at which he supplies, or does he distribute or transmit from one central point? I would also ask Mr. Onslow if he has considered the mixing of the gas and air in equal proportions, such as is adopted in one or two high-pressure installations, and which has the advantage of reducing the amount of air taken in at the point of ignition. In the case of these supplies, what method is he proposing for the registration of gas at such an extremely high pressure?

Mr. E. W. Smith (Birmingham): I am glad to have this opportunity of commenting on Mr. Onslow's paper, especially as I acknowledge him as being the pioneer of all the work that is being done on high-pressure gas. The first information that I obtained on the matter was from reading an account of his work on high pressure before starting in Birmingham, and it just helped to give me that little idea as to the nature of high-pressure gas which was necessary before going on to experimental work. I gladly acknowledge Mr. Onslow as being the real pioneer of all high-pressure gas work in this country. I enjoyed reading his paper very much, as it is essentially the paper of a practical man. Anyone who has to go into commercial industrial works where high-pressure gas might be applied, knows that it is necessary for a specialist in heating to deal with the propositions he comes into contact with, rather than (say) a furnace manufacturer, who has to deal with so many other things that he cannot possibly specialize. It is very useful to all who are considering the question of applying gas to industrial purposes to have before them such practical hints as Mr. Onslow has given in his paper. I am interested to hear that Mr. Onslow has tried this method of using many burners impinging on fire-clay material, and getting a form of surface combustion. I think all who have endeavoured to bring about better efficiency in heating must have tried this method. But there is one essential drawback in all such methods, and it is that in the rebuilding and reconstruction of all furnaces used for industrial purposes—especially melting furnaces and hardening furnaces—it is necessary to be able to reconstruct cheaply and to be free from complications during the work. When you are dealing with a material on which there are a number of flames playing, each of which has to be manipulated, the burner will be likely to be interfered with, and there will be blocking up by scraps and material fluxing from the fire-brick, which will entirely do away with the efficiency that was obtainable in the furnace when it was first started. It is one thing to get high efficiency for the first few days, but it is another thing to be able to keep it going for a few years. The advantage of high-pressure gas, as Mr. Onslow has pointed out, is its simplicity of manipulation. This has been dealt with by Mr. Leather. There is no question about it, as would be shown by those who have tried and have used high-pressure gas. In Birmingham alone, some hundreds of furnaces have been constructed for metal melting consuming from 300 to 500 cubic feet an hour. One firm alone are negotiating with the Corporation for 150 furnaces taking 500 cubic feet an hour. The experience with these furnaces indicates that all the results can be got at 12 lbs. pressure with high-pressure gas that can be obtained by the use of low-pressure gas and an air-blast, with greater simplicity—all the results right up to melting 99 per cent. nickel, and, better still, melting about 80 per cent. nickel

with 10 per cent. iron, which is harder than pure nickel. So that there is no fear, subject to your having proper intelligence behind the construction of the furnace, of any heating proposition being successful with high-pressure gas. I quite agree with Mr. Onslow in his table of the pressures that are necessary for the varying uses of high-pressure gas. I found that nothing more than 100 inches of water was necessary, except for metal melting and high-temperature fire-brick heating. In all forms of metal burners, 100 inches is the top pressure, and even lower than this for blowpipes is quite satisfactory. High-pressure gas is not at all necessary in many instances; and I think this point wants bringing out very carefully. High-pressure gas is only necessary for quick heating, and where very high temperatures above 1000° C. are required. I have seen figures lately reported in the "JOURNAL" of muffles which can be heated up to very high temperatures with a small quantity of gas very quickly. But 90 per cent. of muffle work does not require a temperature higher than 900° C.; and when quick heating is not necessary low-pressure gas can maintain the temperature as satisfactorily as high-pressure gas in my opinion, after the experience I have had in Birmingham. It is in every way quite as good, except where quick heating is necessary at higher temperatures than 1000° C. Do not let us make too much of high-pressure gas being the cure-all of all gaseous questions, because it is not. I again thank Mr. Onslow for all his good work, and I hope in the future I shall be able to repeat the visits that I have made to him before he left Woolwich, and that he will come up to Birmingham and see a little of that of which he is really the father.

The PRESIDENT: Mr. Newton Booth, who succeeded Mr. Onslow at Woolwich, will next contribute a few words to the discussion.

Mr. W. NEWTON BOOTH (Woolwich Arsenal): I should like to add to the few remarks that have been made with regard to Mr. Onslow's work, he being the pioneer of high-pressure gas. His work has been extremely valuable to the industry. The point I should like to refer to particularly is one that was made by Mr. Leather. I quite agree with Mr. Leather that it is absolutely necessary to get the correct mixture, and to inject it into the furnace at the right velocity. Having had some experience of the use of high-pressure gas and high-pressure air, my views are all in favour of high-pressure gas, for this reason—that though my experience is that it is quite possible to get results by mixing high-pressure air with low-pressure gas equal to any that can be obtained by high-pressure gas alone, yet it is a much more difficult thing to keep the mixture correct. Mr. Leather has pointed out that it is necessary to get a correct mixture. I would also ask him to consider that, with most furnaces in general use, it is necessary to get a workman to use them. With high-pressure air, you have first of all the compression of the air, and, secondly, the pressure of the gas; and I think no member of the Institution would put it forward that the pressure of gas in a furnace using high-pressure air will remain constant. That is my experience. If you introduce another burner, it upsets the entire adjustment of the previous burner. It is better to have the gas under pressure. It is possible to keep the pressure at the nozzle of the burner quite constant, and to get the air pressure practically constant too. My experience is that, when it comes to a question of raising the temperature, keeping the mixture correct, and keeping the temperature steady, the workman is far more likely to attain the result by using the gas at high pressure, because he can control it more easily than with air under pressure.

Mr. W. WILSON (Falkirk): May I ask Mr. Onslow if in his experience he considers it advisable or practicable to heat retorts by any process of surface combustion.

The PRESIDENT: That is a poser for Mr. Onslow. I will now call upon him to reply.

Mr. ONSLOW: With regard to what Mr. Webber said about the question of producer gas, I had producer gas most in my mind, but also the mixture of air and gas in ordinary furnaces. With producer gas, there would be variations in temperature—it is a difficult thing to get a constant temperature. But I was not so keen on the question of producer gas in my paper as I was on that of ordinary coal gas. I found it was practically impossible for an unskilled workman to mix air and gas properly, unless the scientist legislated for him. I say this with all reservation. I have the greatest respect for the British workman; but we do not turn out scientists. We ought to be able, as gas engineers, to place a furnace before a workman, and say: "That furnace will give you in 45 minutes 2000° Fahr. There is your gauge. You have nothing to do to it until 45 minutes have gone, and then if you put in your pyrometer or Seger cone that will tell you what you have." We ought to be able to put in the hands of a workman a thing that does not leave him to chance at all. When I first started on this subject, I found it to be most difficult for a man to get two one hour's runs at the same temperature; and why should he be allowed to mix air and gas, first dodging in a little air, and then a little gas, getting 1500° one minute, and half-an-hour afterwards getting something else, so that he does not know what he is getting? I thought it was time that gas engineers should be able to place a certain thing in the hands of the man, and tell him exactly what he had to do, so that the manager could say: "There is your furnace. At a certain time you will get your temperature, and you have nothing else to do. All you have to do is to open your taps wide." I do not care whether it is twenty or thirty furnaces, varying from 1000° to 2700°. It does not matter what it is, you ought to be able to give the man a battery, and tell him exactly what he has to do. I believe it is possible, and I do not think it will be long before the great engineering firms in the country will be working on a more scientific method of gaseous heating. Directly this comes about, the question of coal for heating will be a negligible quantity. At present we want something like this for heating purposes. Coal is very problematical. Engineering firms first of all want something placed in their hands so that nothing is left to chance; and if we devote our time and attention to that, it will be an excellent thing for the gas industry and for manufacturers generally. I think Mr. Leather's question has been answered. With air under pressure and gas under pressure together, unless they are both equal, there is a difficulty. You can get a higher temperature with air under pressure than you can with gas under pressure, but my difficulty is that when you have the air under pressure you are liable not to get an exact mixture of air and gas, the same as you would if you had a fixed gas pressure and took the air under atmospheric conditions. I have had air under pressure and gas under pressure, and sufficient temperature to melt platinum. The melting of nickel was very simple. Mr. Edwards spoke of 15 lbs. pressure, and also as to the methods of registration, and said this is a difficult matter with gas under pressure. But in most isolated cases in small installations you simply draw the gas through the meter. There is a meter made by Messrs. Parkinson and Cowan which registers correctly with varying pressures from 2 up to 6 or 7 lbs. per square inch. I will not say it registers absolutely correctly, but they put it within 2 per cent. up or down. So far as my tests go, it has been satisfactory, but my experience principally has been with drawing gas through the meter, and not placing it under pressure from the high-pressure supply. Probably Mr. Smith, who has had a lot of experience in Birmingham, might have told you more with regard to this. I believe they are using it very largely in Birmingham, and they must register the gas under pressure, You can, of course, take your gas from one central point. I have had an instance where we had one central supply, and we used it for hardening or anything else, by having a central point and taking the pressure down to where it was necessary. I thank Mr. Smith for the kind words that he has used. It is a little pleasure to hear what he has said after the study I have given to the method which is so dear to my heart. I also thank Mr. Booth for his words. It is nice to know that one's efforts are not absolutely fruitless.

On the invitation of the President, Mr. Meunier gave a short *résumé* of his paper before Wednesday's proceedings ended. The paper itself will be found on p. 861.

A LABORATORY METHOD FOR COMPARING THE COKING PROPERTIES OF COAL.

By R. LESSING, Ph.D., F.C.S.

In introducing the subject with which this paper deals, the author finds himself obliged, in view of the title, to ask the indulgence of an assembly of practical men for bringing before them a matter which might at first glance appear to be of purely theoretical interest. He is aware that a preponderant majority of those engaged in the industry views

laboratory methods with a certain amount of distrust; and in view of recent sayings and writings expressing the illusory value of laboratory tests as against large-scale trials, he might have felt diffidence when choosing this title.

The author would, however, at the outset like to disarm criticism in this respect by stating that he is fully alive to the fact that the proof of the value of any industrial process can only lie in its practical application on the large scale; and he recognizes, and readily admits, the limitations of small-scale laboratory work. But no one will dispute the fact that similar limitations—which may be in other directions—attach to work on the large scale, and especially to the control one has over reactions where large masses are involved. The limitations of large-scale processes become particularly apparent when it is desired to obtain information as to the effect of individual factors governing such processes, for the sequence of occurrences is necessarily largely obscured by overlapping. And only by reducing quantities to a minute scale, and rigidly controlling all conditions of procedure, is it possible to definitely ascertain the effects of any one factor. For this, the small-scale experiments are, in the author's opinion, highly suitable; and he ventures to hope that some of the results he has obtained will prove his contention and convince the meeting that laboratory work in this direction is not altogether valueless.

The Process of Coal Carbonization.

The first series of experiments out of which this investigation arose was prompted by a desire to obtain an actual insight into the process of the carbonization of coal. Somewhat innocently, it was thought that this pious wish could best be fulfilled by carrying out the carbonization in a transparent vessel; and as glass would melt long before any of the temperatures required are reached, recourse was taken to the fused silica glass which has now been on the market for a number of years. This material can be heated to 1300° C. without damage, and has the additional advantage of not altering its volume upon heating or cooling.

In order to have an absolute control over all the conditions of procedure, the quantity of coal dealt with was only a few grammes in the early experiments, which date back over a year. Later on a further reduction was considered convenient; and a standard quantity of one gramme of coal was employed for all subsequent work. All the results compiled in this paper were obtained on this scale.

The retort employed consisted of a silica tube, closed at the bottom and flanged on the top, suspended in a suitable way. The powdered coal was placed in the tube, and this was heated with a bunsen burner. In spite, however, of contrivances intended to deflect the flame from the bottom, and heat the sides only, the lower part of the coal charge got hot quicker than other parts; and the gas evolved forced the coal powder up, and out of, the tube. After all attempts at even heating by a gas-flame had failed, heating by electricity was resorted to. Thin platinum wire made into a coil of about 2 to 3 mm. diameter was coiled round the "retort" tube. By this means not only was the heat concentrated where required, but the coil also clung to the tube by its own elasticity sufficiently to prevent its moving out of position.

At this stage, the sanguine expectation that one should be able to follow the coking process by looking through the silica wall of the "retort," led to premature disappointment; for the resistance heating coil had to be sufficiently insulated against undue losses of heat by radiation. This was achieved by packing non-conducting material round the tube. In order to avoid the formation of silicates, Kieselguhr was used for this purpose.

It was first intended to employ an evacuated silica glass

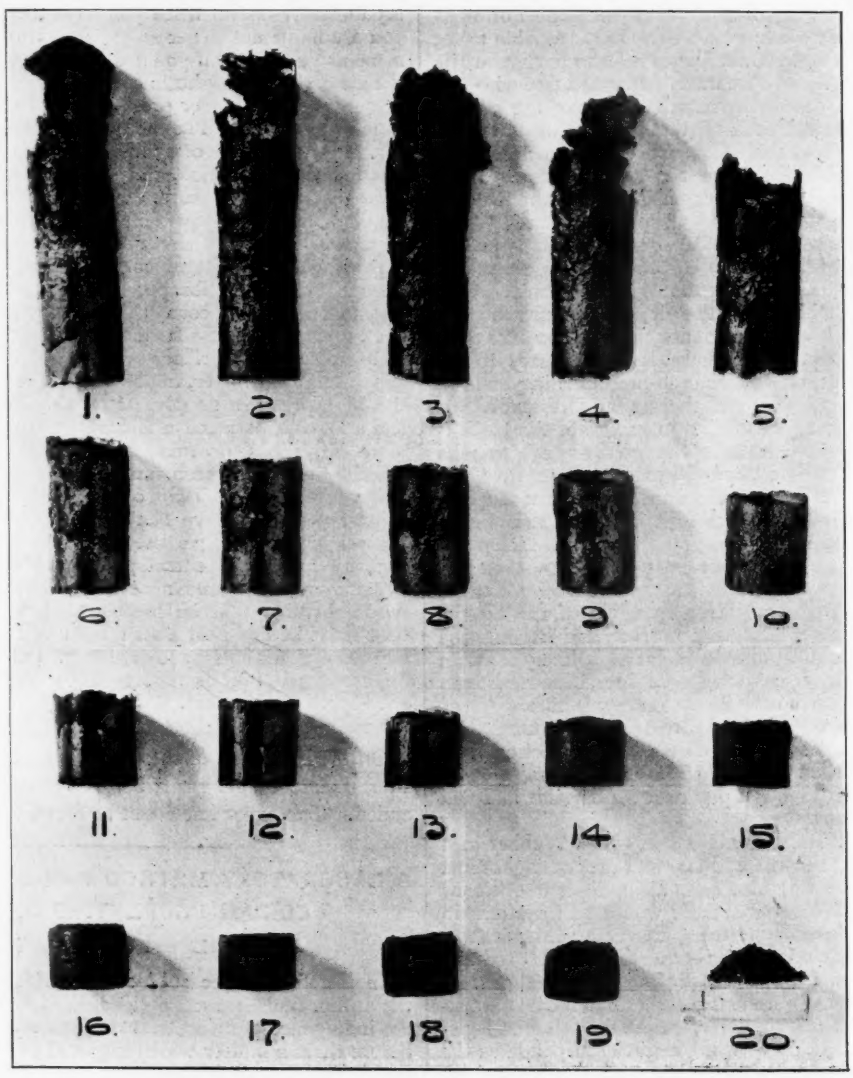


Fig. 1.—Cokes Obtained from Twenty Different Coals.

jacket as insulating medium; but the fusing-in of the platinum wire presented some difficulties. Moreover, sufficiently interesting observations in other directions had been made by that time to make transparency a consideration of minor importance. The swelling properties of coal came out very clearly by this method of heating; and this offered a fruitful field of research. To prevent the coal from being blown out of the tube, a weight had been employed in the early experiments, consisting of a piston made of fire-clay and, later on, of silica tube. With the new form of heating, this piston could be employed for indicating with great precision all the volume changes which the coal and its solid residue undergo on coking.

It was found that coals differ very widely in the extent to which they expand during various periods of the charge and after complete coking. Although it would be quite feasible to make the coking coal write its own story by attaching a suitable lever arrangement to the piston which records a chart on a rotating drum, this would introduce a complication which was dispensed with, as a close observation will show the difference in the behaviour very markedly to an experienced worker. But it is quite simple to record permanently the size, shape, and general properties of the resultant coke; and it will be seen from the coke specimens shown in fig. 1 (which were obtained from one gramme each of twenty different coals) that the variations are very striking.

From the following table of analytical data for these coals, it may be observed that they do not differ very widely in their composition as brought out by the usual tests, even including coal No. 20, which flatly refused to be coked in spite of its containing 32 per cent. of volatile matter.

		Air-Dry Coal.				Coal Substance.	
No.	Lab. No.	Moisture.	Volatile Matter.	Carbon.	Ash.	Volatile Matter.	Carbon.
1	833	0·74	30·42	64·52	4·32	32 04	67 96
2	829	0·48	33·92	64·04	1·56	34·64	65·36
3	312	0·75	27·44	63·23	8·58	30·27	69·73
4	827	0·65	30·55	64·23	4·57	32·24	67·76
5	826	0·53	28·48	64·52	6·47	30·61	69·38
6	825	0·87	33·67	61·82	3 64	35·26	64·74
7	836	0·54	33·39	61·82	4·25	35·07	64·93
8	834	3·88	27·31	64·68	4 13	29·68	70·32
9	843	1·18	36·37	59·86	2·59	37·79	62·21
10	847	1·18	25·89	66·41	6·52	28·06	71·94
11	844	1·42	37·15	58·36	3·07	38·89	61·11
12	828	1·54	36·80	60·06	1·60	38·00	62·00
13	835	3·15	35·98	58·63	2·24	38·03	61·97
14	845	1·62	35·93	59·92	2·53	37·48	62·52
15	696	9·87	32·12	50·33	7·68	38·96	61·04
16	328	1·70	33·12	57·42	7·76	36·57	63·43
17	468	5·16	33·23	54·29	7·32	37·97	62·03
18	467	7·77	34·14	54·15	3·94	38·67	61·33
19	463	7·07	35·21	54·80	2·92	39·12	60·88
20	694	5·63	32·19	57·05	5·63	35·74	64·26

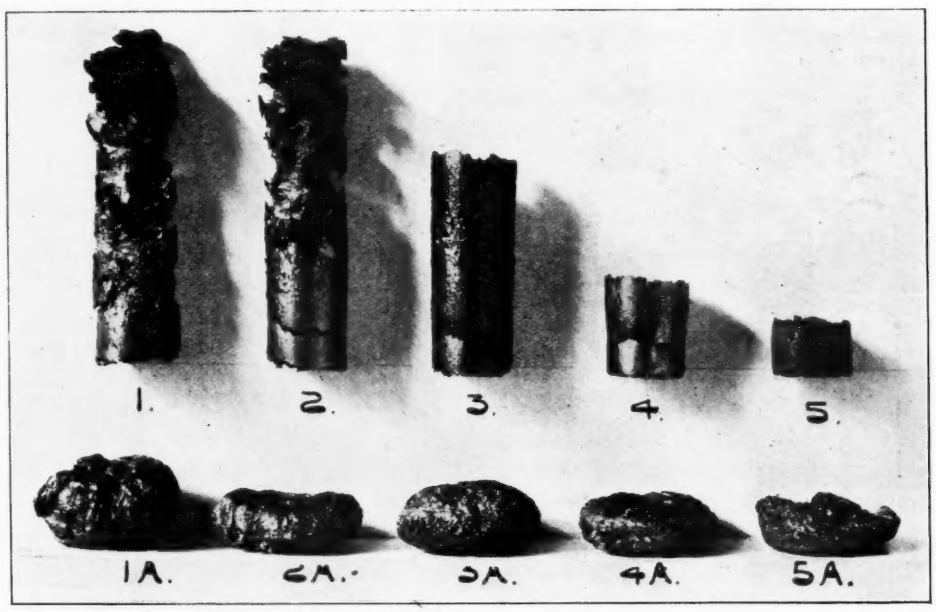


Fig. 2.—Comparison of Cokes Obtained by New Method and by Old Crucible Method.

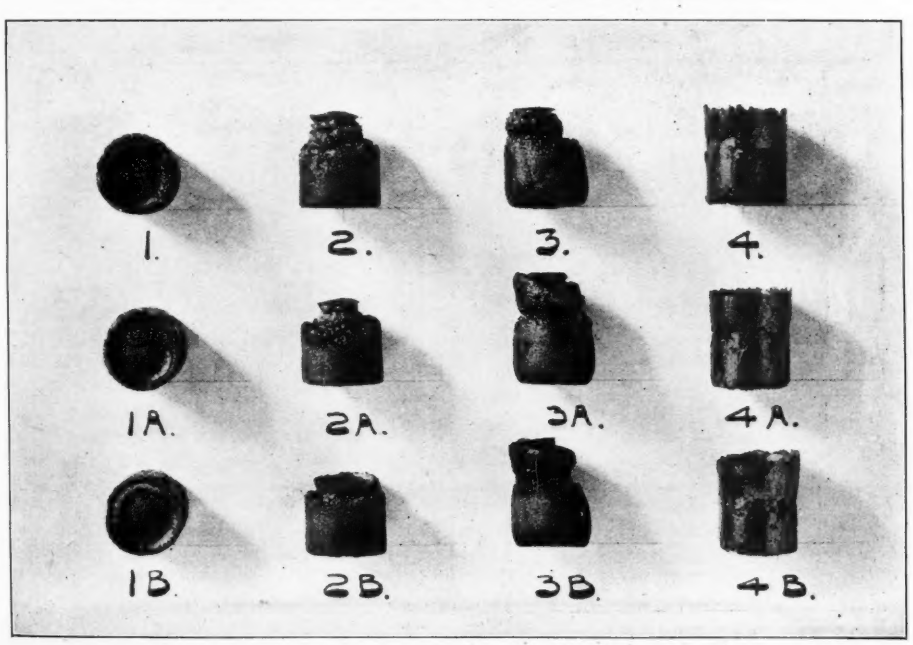


Fig. 3.—Showing Constancy of Shape and Character of Coke Obtained from Each Coal.

It was found more convenient not to place the coal in the heating tube itself, but to use for this purpose a second tube, in muffle fashion, which could easily be taken out for weighing and cleaning. The procedure is to weigh one gramme of coal powder of definite fineness into this inner tube, and place the third, or piston, tube into it before commencing the test. By filling the piston tube with quartz powder, the weight of it can be altered at will. This method was found to replace or supplement to great advantage the ordinary crucible test for determining volatile the matter in coal. The method was described in detail and discussed from the analytical point of view in a paper read by the author before the Society of Chemical Industry.

By confining the coal sample in a closed space of definite cylindrical shape and regulating the temperature in the various heating zones, the irritating influence of the oxidizing atmosphere in the ordinary platinum crucible method and of secondary decomposition is eliminated. Thus it is claimed for the method, as a purely analytical one, that it attempts standardization of this important test with a certain measure of success.

Coke Production.

The superiority of the method is, however, not restricted to the determination of volatile matter in coal; the appearance of the coke itself should prove very valuable in distinguishing various kinds of coal. Fig. 2 shows a comparative set of five coke specimens; the top row being obtained by the new, and the bottom row by the old crucible, method from identical coal samples. It might be argued that the shape and character of the coke is dependent upon chance; but a glance at fig. 3 will disperse all doubts in this respect. Here three specimens are shown for each individual coal; and the resemblance, even in points of minute detail, is very striking. Altered experimental conditions will, of course, produce different results; but the same conditions will always yield identical results from one particular coal. On the other hand, it is useful to

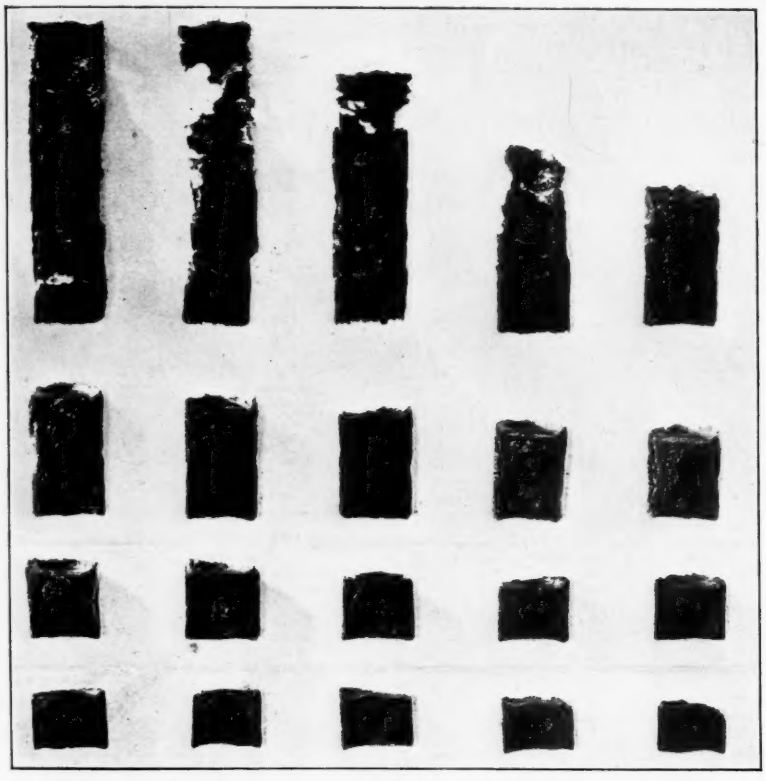


Fig. 4.—Sections of Coke Specimens from Different Coals.

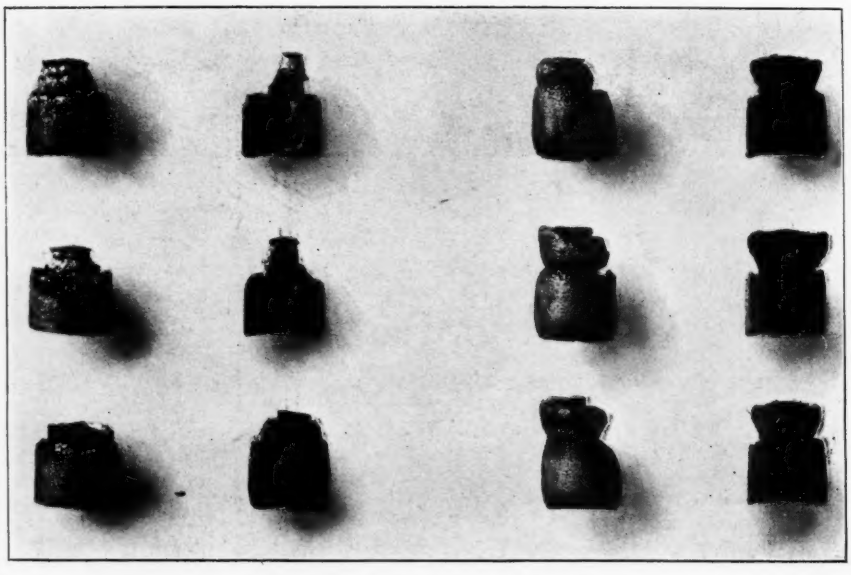


Fig. 5.—Comparisons of Coke Specimens with their Sections.

inquire how various coals behave under varying conditions; and the experimenter has here an unlimited scope for work with this apparatus.

The character of the coal and its behaviour during carbonization become still more apparent when studying the inner structure of the coke. Sections can be prepared of the little coke cylinders; and the twenty specimens shown in fig. 4 will tell their own tale. In fig. 5, the second and third columns of fig. 3 are compared with sections made of similar specimens. The sections explain more readily the quaint, mushroom-like shape of these cokes. Obviously, the period of semi-plasticity in the carbonization of these coals is of very short duration, and the outer layers become rigid before the heat has penetrated into the interior. When this happens, the top bursts with explosive force. During the formation of the bottom specimen in the second column, two little explosions were actually observed, corresponding to the two inverted cones visible in the section. The coal represented by this sample is known to have actually given trouble both in gas-retorts and coke-ovens.

Volatile Products.

This method therefore offers a ready means of studying carbonization phenomena by looking at the coke produced —a proceeding advocated by the author on various occasions. At the same time, it was thought that the apparatus could be extended for the study of the volatile products. Although a fair picture could be gained by observing the quantity and thickness of tarry vapours and gases evolved during various periods of each test, the author went a step further by closing the "retort" tube and connecting it to a gas collecting system.

The inner tube was adapted by making it somewhat longer and providing it with a side tube and a stopper in the top. The side tube slides into a specially-designed tube in which the tar is collected, and after ascending through some cotton wool, which retains traces of tar, and through a purifying agent, the gas flows through a two-way tap into a graduated collecting tube connected with a levelling bottle; seal being made with a glycerine solution saturated with coal gas. The piston tube was replaced by a solid piston made of quartz glass rod and provided with a hook whereby it can be drawn out from the retort after every test. The stopper may be perforated for the insertion of a thermo-couple for temperature readings, and of a silica tube for the introduction of inert gases, such as carbon dioxide or nitrogen, or of steam.

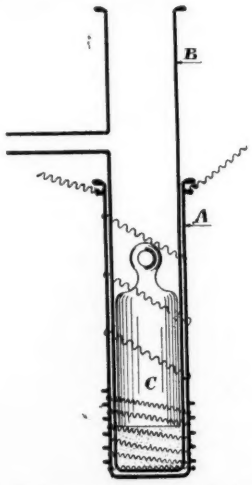


Fig. 6.—Diagrammatic View of the Apparatus.

Fig. 6 gives a diagrammatic view of the essential parts of the apparatus. A is the outer heating tube, B the "retort" tube, and C the piston. Quartz pin points on A serve to keep the platinum coil in position. The whole is packed in infusorial earth in a metal casing mounted on a rheostat, which allows the regulation of the current resistance and thereby of the temperature.

Fig. 7 shows the complete apparatus as used for this investigation. An ammeter is employed for ascertaining the heating current. A millivoltmeter shows the action of the thermo-couple, which is held in position by a silica tube with the contact in the middle of the coal. A water-gauge connected by a T-piece shows the actual pressure inside the

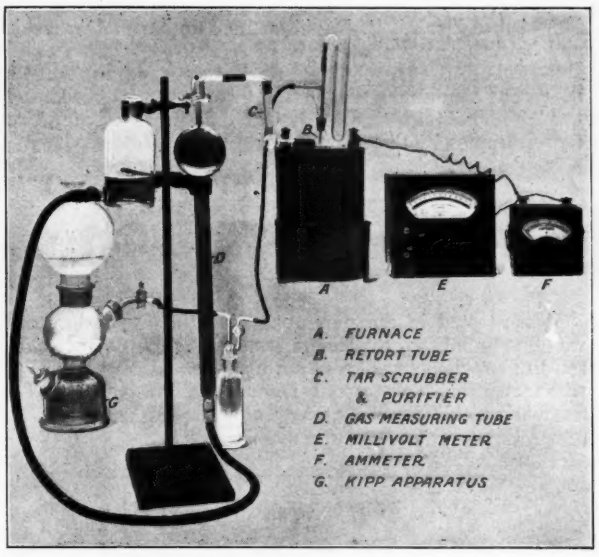


Fig. 7.—Complete Set of Research Apparatus.

retort. This is always kept at zero. A Kipp apparatus supplies carbon dioxide for flushing out the retort before and after the test. This is only necessary when an analysis of the gas is required. The amount of added carbonic acid can be read off directly, or results are returned for carbonic acid-free gas. When working over mercury, the air can be removed by evacuation. Once the apparatus is standardized for various temperatures, the thermo-couple and millivoltmeter can be dispensed with; also the ammeter, provided a constant supply current is available.

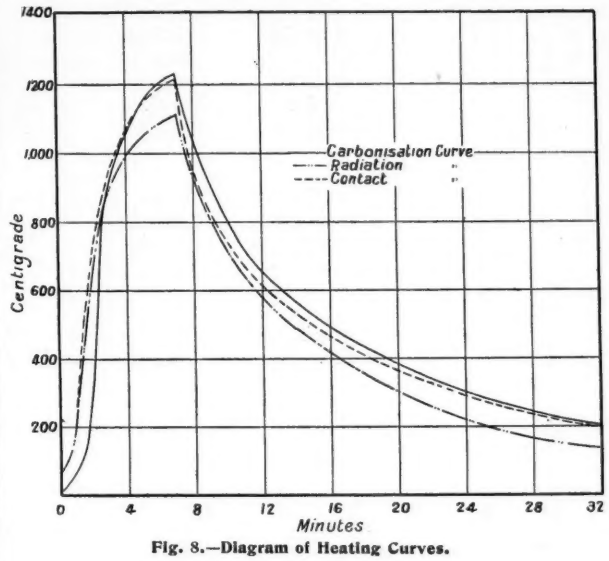


Fig. 8.—Diagram of Heating Curves.

Fig. 8 represents some typical heating curves such as are obtained in the standardization of the apparatus. These three curves show the temperature gradient (*a*) with the thermo-couple in the empty tube heated by radiation, (*b*) with the thermo-couple in contact with coke, and (*c*) with the thermo-couple in the middle of a coal charge. The current was switched off in each case after seven minutes, when constancy was practically reached.

When making a test, the colour and character of the tar vapours evolved at various periods should be carefully observed. The rate of gasification can be followed by noting the volume at stated intervals. Coals may differ considerably in this respect. If no analysis of the gas is required, the volume is ascertained after the gas has acquired the temperature of the room, and is corrected for temperature and pressure in the usual manner. The number of cubic centimetres obtained are equal to the number of cubic metres per metric ton of coal carbonized. The factor for conversion into cubic feet per ton is 35·88.

In order to test the value of the apparatus for comparisons with large-scale results, a series of experiments were made with coals for which results are well known. The author is

indebted to Dr. W. B. Davidson for samples of Derbyshire and Yorkshire coals which were submitted to such extensive trials in the Birmingham testing works as published in his recent communications to the "JOURNAL OF GAS LIGHTING."* The following analytical data were obtained for these samples by the usual tests:

	Derbyshire Coal. Lab. No. 936.		Yorkshire Coal. Lab. No. 938.
Moisture	5·39	..	1·71 per cent.
Volatile matter	34·84	..	36·49 ,,
Carbon	52·56	..	53·14 ,,
Ash	7·21	..	8·66 ,,
	100·00	..	100·00 ,,

When tested in the new apparatus, the Derbyshire coal was first submitted to the temperature stated by Dr. Davidson to have been employed during his trials in horizontals when charging—viz., about 1100° C. or 2000° Fahr. The following yields were obtained; all volumes being reduced to 60° Fahr., 30 in. bar., and moist gas.

277·8 c.c.	9,967 cubic feet of gas per ton of coal carbonized
276·8 ,,	9,932 ,, ,, ,, ,,
278·0 ,,	9,972 ,, ,, ,, ,,
277·1 ,,	9,942 ,, ,, ,, ,,
Average 277·4 c.c.	9,953 cubic feet of gas per ton of coal carbonized

Although this figure is considerably below that obtained on the large scale, the results are quite compatible, considering that in these tests the tar was not subject to the same amount of secondary decomposition as in the gas-retorts, even with heavy charges. At the same time, it was assumed that the temperature in the Birmingham retorts must have risen considerably higher during the charge; and therefore tests were made at a temperature of 1300° C. (2375° Fahr.), when the following yields were obtained:—

288·5 c.c.	10,352 cubic feet of gas per ton of coal carbonized
295·1 ,,	10,588 ,, ,, ,, ,,
Average 291·8 c.c.	10,470 cubic feet of gas per ton of coal carbonized

As this figure agrees remarkably well with the average yield (free from added inert gas) which Dr. Davidson obtained from this coal—viz., 10,447 cubic feet per ton—some claim for usefulness may be made for the apparatus. As a further example, a test at low temperature may be quoted. At 500° C. (940° Fahr.), 160 c.c. = 3834 cubic feet per ton were obtained.

It will thus be seen that the method not only gives good results from the coke-making point of view, but also produces valuable information on the gasification properties of coals under various conditions. The fact of starting hot or cold does not influence the make appreciably. Further variations may be introduced by altering the weight of the piston, or carbonizing without the piston, by adding water or chemicals, lime, sand, &c. Steam may be introduced for the making of water gas.

COMPOSITION OF THE GASES.

With regard to the composition of the gases, the following results should be of interest:—

Gas free from carbonic acid and sulphuretted hydrogen.	C_nH_m	O	CO	CH_4	H	N
Derbyshire coal starting cold	1·77	0·29	10·30	32·35	53·59	1·88
,, ,, ,, hot	2·28	nil	11·51	28·50	55·63	1·88
Yorkshire coal starting cold	1·68	nil	8·85	33·33	54·18	2·01
,, ,, ,, hot	2·50	nil	8·86	29·95	56·46	2·00

Against these may be put the average comparison of the gases as ascertained by Dr. Davidson in his large-scale tests. For convenience of comparison, these were calculated for gas free from sulphuretted hydrogen, carbonic acid, and added nitrogen.

	C_nH_m	O	CO	CH_4	H	N
Derbyshire coal in horizontals	3·33	0·53	10·51	31·18	53·44	1·02
,, ,, ,, verticals	2·68	0·44	11·25	28·14	56·48	1·02
Yorkshire coal in verticals	4·13	0·59	7·06	32·88	54·35	1·02

The composition of the gas made in the test and on the large scale is practically identical. Except in the case of unsaturated hydrocarbons, the figures all agree extremely well. The lower values for these might be explained by the efficient scrubbing which the gas experiences in the test when passing through cotton wool impregnated with tar; but the reproduction of the carbon monoxide, methane, and hydrogen ratio renders this discrepancy fairly insignificant. In the case of the Derbyshire coal tested, it might even be inferred that the difference in working conditions (starting hot or cold) corresponds to the difference in the carbonizing systems. With some caution in the explanation of results, the apparatus should prove of value in comparing the suitability of various coals for different systems.

* Vol. CXVII., pp. 664, 880; Vol. CXVIII., pp. 43, 99, 213.

CONCLUSIONS.

In conclusion, the author cannot advocate too strongly the exercise of caution in the explanation of the results obtainable with his apparatus. It is not intended for, and will never be capable of, perfectly reproducing works operations on a diminutive scale. It would therefore be a harmful proceeding to translate the results it yields into commercial values without due regard to all factors which come into play. But while recognizing and applying the limitations of work of this character, the method should prove exceedingly useful in many directions when attempting to solve problems connected with the gas and coke industry.

The few results included in this paper are representative of a good many others which the author has obtained by his method, and are only incorporated to show its applicability to various purposes. It serves to elucidate many individual factors attending the carbonization of certain coals, and it allows a large variety of conditions to be applied with great ease. Its principal field of employment, however, should be the comparative testing of coals. The aspect of the coke obtained supplements in most cases the information available from the customary tests. The gas yield gives, if nothing else, a good indication as to the composition of the volatile matter contained in the coal, and would show any appreciable oxygen contents of the coal—a fact which is not brought out by simply ascertaining the amount of volatile matter.

The method, however, can only be of value if a great many coals of different origin and character are tested and the results recorded. Only by co-ordinating experiences gained by the examination of a great variety of specimens can the principles be ascertained which guide the phenomena so far observed in the comparatively limited number of cases accessible to an individual worker.

The author therefore cordially invites the co-operation of others in this interesting field of research, and trusts that the benefit to the industry which may arise therefrom will amply repay what little he has been able to contribute towards this end.

Discussion.

The PRESIDENT: I feel sure that you will agree with me when I say that this is a most valuable contribution to the proceedings of the Institution. I could not help thinking, while listening to Dr. Lessing's explanation of the slides, and while he was leading us so nicely through the various stages of this little process of his, that really it was, after all, more in the form of a lecture than a paper. May I, therefore, treat it as such, and call upon Dr. Colman to propose a vote of thanks to Dr. Lessing.

Dr. HAROLD G. COLMAN (London): I have great pleasure in rising at your suggestion to propose that the heartiest thanks of the meeting be given to Dr. Lessing for his lecture-paper. In doing so I suppose that I am intended to discuss the paper to some extent; but in that respect I feel myself in some difficulty, unfortunately, from the point of view of discussion, because I agree with the whole of it. There are perhaps one or two points which I might mention, with regard to Dr. Lessing's remarks in connection with the value of small-scale experiments. Of the value of such small-scale experiments in complex matters, such as carbonization, I am free to confess to being fully convinced. At the same time I think the warning Dr. Lessing gives is equally necessary—namely, that in interpreting the results of these small-scale experiments a great deal of common-sense must be exercised. Treated by themselves, and without such proper consideration, they may do more harm than good. But without such small-scale experiments properly considered, we cannot expect to advance in such complex matters as carbonization. The original intention, I understand, of Dr. Lessing lay in connection with the coke. Of course, I have had the pleasure of seeing these various experiments in progress, and have heard probably a great deal more about them than is contained in the paper. Many of us have received much assistance in our examination of coals from the crucible tests. There is no doubt that, so far as the volatile matter is concerned, it has given us a great deal of information; and, so far as the coke is concerned, we could get a great deal of information as to the nature of the coke produced by the examination of that contained in the crucible. But Dr. Lessing makes a very

marked advance with regard to the nature of the coke. Those of you who have had opportunities, as I have had, of not merely seeing the slides, but of actually seeing the samples of coke and the remarkable sections, will see that it does open up opportunities for our learning a great deal more of what takes place so far as the formation of coke is concerned in carbonization than has hitherto been brought out. We must admit that at the present time we are in a state of exceedingly great ignorance as to the nature of the coking process, even more than we are in as to the nature of the gasification process. Dr. Lessing has also referred to the point that this may be a directly useful method for identification of coal samples. Certainly the way in which these samples, on a repetition of the test, give coke of such extraordinary characteristic and definite appearance does offer to us a method of being able to be sure that the coal that is being sent in to us is the same as that which was originally tendered for. In some cases, this may be a considerable advantage. With regard to the last portion of the process, the gasification results, I at present feel in the position that, like Oliver Twist, I want more. I know Dr. Lessing agrees with me in this, and I feel that we cannot come to a definite conclusion in the matter till a larger number of samples have been treated in the way Dr. Lessing has done. At the same time, it is a most extraordinary thing that the gas results obtained by Dr. Lessing on the 1 gramme sample under many different conditions should be so remarkably close to those obtained by Dr. Davidson on the 20-ton a day plant of horizontal retorts. The fact that they come out so close makes it essential that further work should be done with the apparatus. I hope before long many of us will have an opportunity of carrying out experiments with it, because I do not think Dr. Lessing wants to keep all the experimenting to himself. From these results no doubt further information as to carbonization will follow, which will also react on our large-scale working. These experiments of Dr. Lessing and those which have been recently published by Messrs. Burgess and Wheeler do tend to increase our knowledge on this subject; and anything that does so is, I think, heartily welcome to all the members of the Institution. I have much pleasure in proposing a hearty vote of thanks to Dr. Lessing for his valuable contribution.

Mr. A. F. Browne (London): I am sure, Sir, you will not expect me, while seconding this vote of thanks, to attempt any discussion of the paper itself. We have all listened to Dr. Lessing's lecture with the very greatest interest, and I have no doubt we shall all read the paper in time to come with avidity. Dr. Lessing is one of a comparatively small body of scientific men in this country who are giving the most valuable services to the gas industry, more especially in connection with problems of carbonization. Dr. Lessing is a gentleman who, I am quite sure, is fully fitted in every way to carry on this independent analysis, to design his own apparatus, and to adapt his means to the desired ends. We thank him most heartily for what he has done for us to-day. We expected nothing less when we saw his name on the list of authors than that we should be highly instructed by, and greatly delighted with, his lecture-paper.

The President: I may just add one word here, and that is that the event has justified the extraordinary action I took when I learned that Dr. Lessing was making investigations on these lines, to prevail upon him to submit the result of his work to this meeting to-day. I assure you the difficulty was not decreased when I discovered that he was about to make certain domestic arrangements which would no doubt considerably interfere with the even tenour of his way. However, he has risen to the occasion, and on that account, if on no other, he is entitled to our thanks. I therefore ask you to support the vote of thanks that has been so nicely placed before you by Dr. Colman, and seconded, may I say, on the extremely practical side, by Mr. Browne.

The vote of thanks having been unanimously carried,

Dr. Lessing said: Since my paper has been declared to be in the nature of a lecture, I do not know whether it is necessary to reply to the discussion which would have followed a paper. I should like to express to you my deep sense of gratitude for the appreciation that you have shown for my little efforts. I must acknowledge especially the kind suggestion of the President, which was largely instrumental in bringing about these researches—at least from the gas makers' point of view. I should like formally to declare here, as part of the discussion, that I certainly do invite most cordially the co-operation of all you gentlemen, and all others interested in this field of work, and to say that I do not by any means try to usurp to myself the use of this apparatus. I am quite certain that the efforts of an individual would not be good enough, and would not cover a wide enough field, to bring out all the use that ought to result from any such method. I can only repeat my thanks for the patience with which you have listened to me, and for the kind way in which you have received my paper.

EVOLUTION OF THE STOCKPORT GAS-WORKS.

By S. MEUNIER, of Stockport.

[As the author mentioned in the course of his paper, many of the extensions at the Stockport Gas-Works since he was appointed Engineer were described in the "Journal" in 1907—in a series of articles in the numbers for April 9, 16, and 23. We then gave a number of the illustrations he now submitted with his paper, and to these may refer readers.—Ed. J.G.L.]

In 1894, it was the author's privilege to submit to the Institution some particulars of gas-works extensions at Stockport; and in fulfilment of a long-standing promise to the President, who thought the subject might be of interest to the members, an endeavour is made in the present paper to show the progress of the undertaking since that date, and the lines on which the Portwood station (now the only station manufacturing gas) has been evolved. The original works at Millgate, which had a capacity of only about 230,000 cubic feet per day, were designed by the author for, and have now for some years been, the electricity works for the town. Plant equal to 3750 H.P. is installed. The other works, at Heaton Lane, of a capacity of about 900,000 cubic feet per day, have also been dismantled; the only portion of the plant now in use being the two gasholders (equal to about 900,000 cubic feet total storage capacity) and the 24-inch governor regulating the supply to the section of the town situated north of the River Mersey.

The works carried out up to the time the 1894 paper was read consisted principally of additions to the carbonizing plant at both the easterly and westerly ends of the retort-house, as may be seen by a reference to the key plan showing the progress made every five years from 1890, and comprised increases in production from 750,000 to 2,500,000 cubic feet per day. It left the retort-house of a total length in the centre of 345 feet; and it was estimated that further alteration to the old benches might enable the make to be increased to 3,000,000 cubic feet per twenty-four hours.

It should be mentioned that, on taking up his duties at Stockport, the author carefully considered the possibilities of the Portwood site, afterwards laying down a general scheme for future extensions, which was very kindly gone into with him by his previous chief, Mr. Charles Hunt, and the late Mr. Alfred Colson; and this scheme has been pretty generally adhered to throughout.

It is not intended in this paper to give very full engineering details of the various portions of the works carried out, as members are quite conversant with such matters. From time to time, however, difficulties of a local nature have arisen, the methods of overcoming which may be of interest, and these it is proposed to make the principal features for treatment.

Removing from Millgate to Portwood.

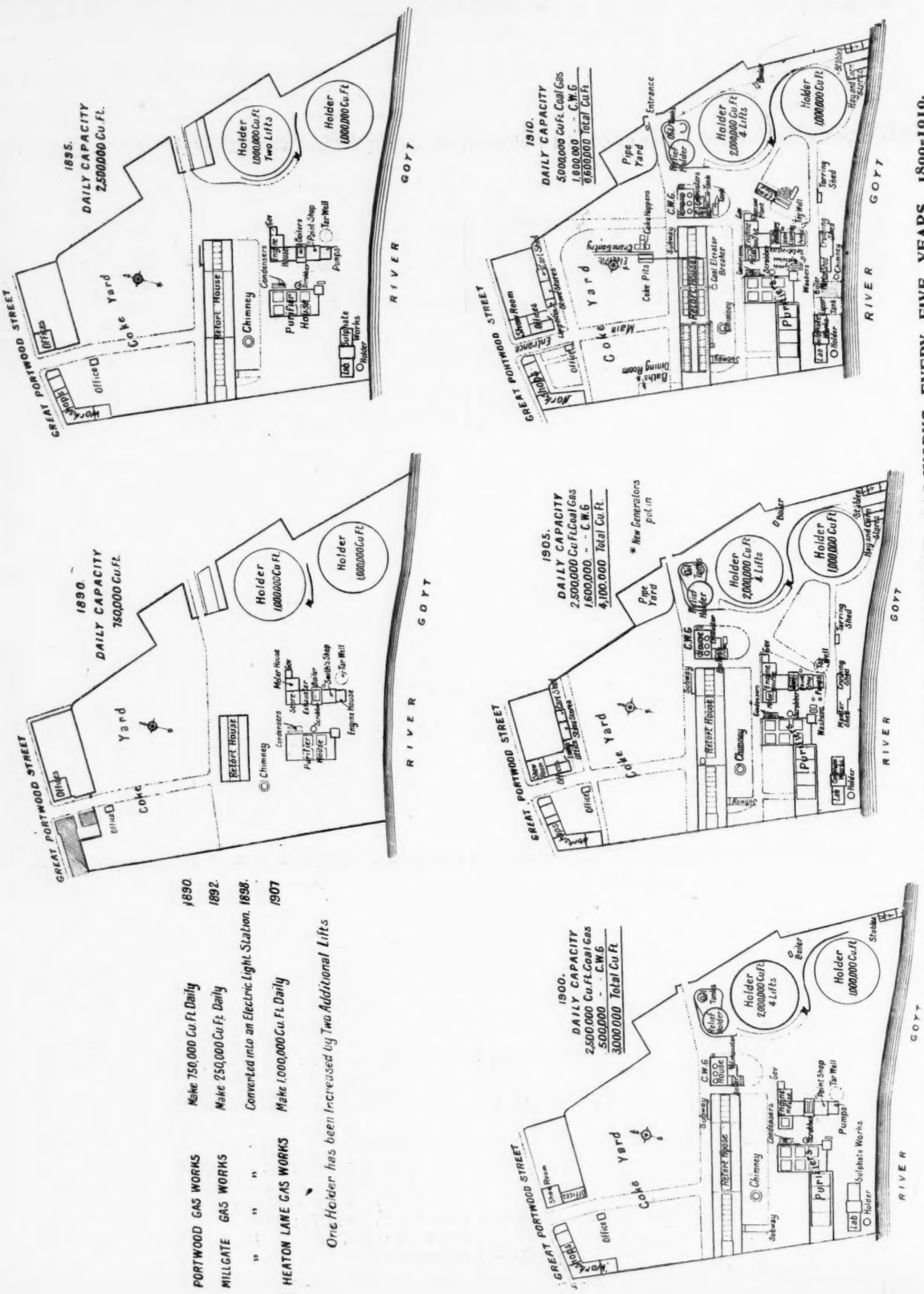
In 1895, it was decided to remove from the Millgate works to Portwood, and, accordingly, plans were prepared for the necessary new workshops, which were arranged to front the main street, and, on the west side, to abut upon the Corporation Cattle Market. In order to do this, the General Purposes Committee were induced to transfer some front land from which the property had been removed, so enabling the boundary to be brought up to the main building-line of the street.

The Workshops, &c.

These consist of joiners' shop, 33 ft. 10 in. by 30 ft.; blacksmiths' shop, 31 ft. by 30 ft.; mechanics' shop, 37 ft. by 30 ft., under the same roof as the blacksmiths' shop, and reached from the latter by steps to allow for differences in level of floors; meter repairing shops, 33 ft. 6 in. by 30 ft.; test room, 22 ft. by 15 ft.; painters' shop, 25 ft. 6 in. by 30 ft.; and coke office. It may be mentioned that at either end the angles of the building vary considerably, which necessitated some rather special work in the roof principals and hips. The difference of level of the street and works has

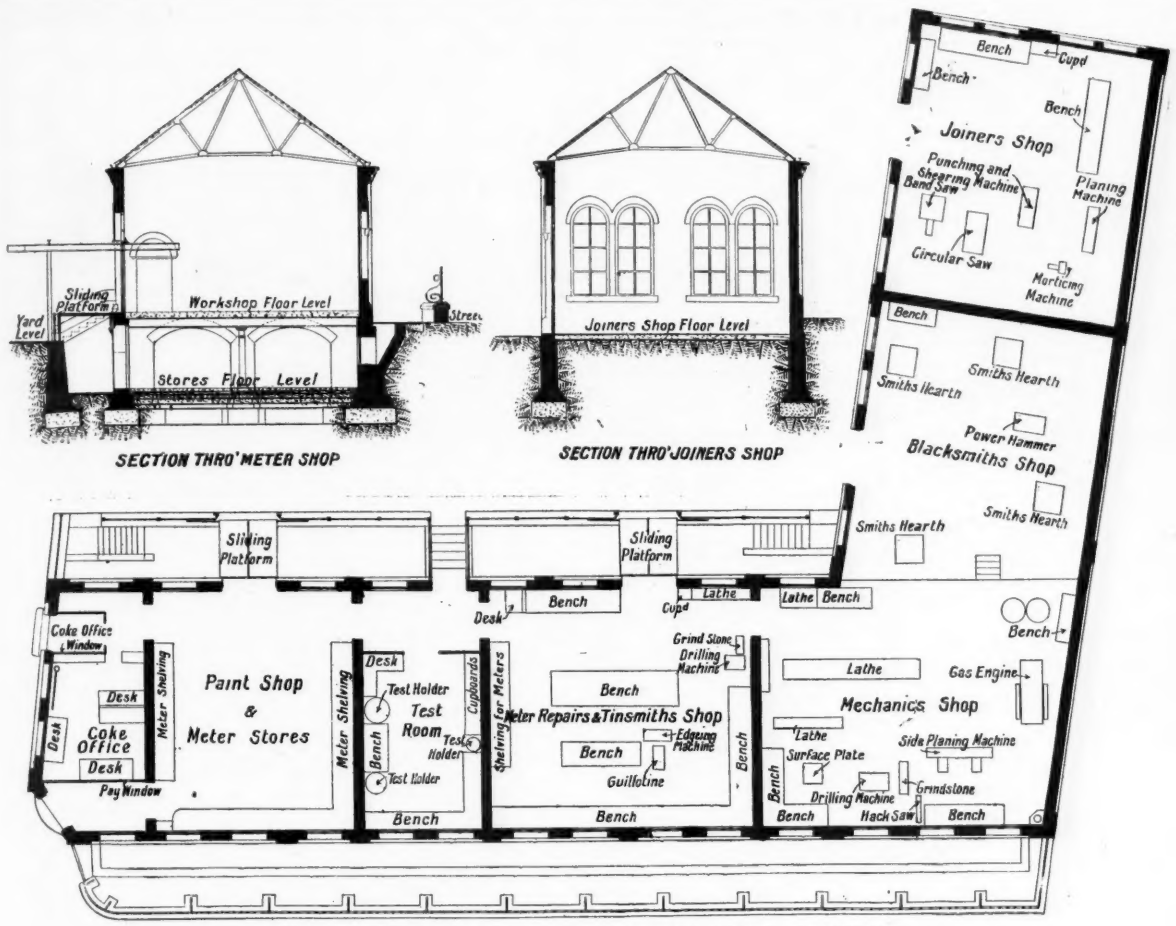
been taken advantage of to give light to the works' stores, which occupy the basement and extend the full length of the street frontage. This is done by means of a window area in front, and by an open subway on the works' side; both being lined with white glazed bricks below the ground level. Heavy goods are lowered into the subway by means of chain block pulleys running on fixed joists extending into each of the meter and painters' shops and over a movable platform; the idea being to provide for the easy manipulation of heavy goods for stores, and that all meters, large or small, should pass into the meter repairing shop, and, after being dealt with throughout the various sections, be passed out at the other. There is also a travelling crane in the mechanics' shop which enables all heavy work to be taken from any portion of the blacksmiths' shop and placed, when necessary, on any of the lathes or machines. The number of men usually employed in these shops is about 34.

The arrangement of the drive to the main shaft in the joiners' shop was very awkward, owing to the obtuse angle of the outside walls; and it was decided ultimately that rope-driving gave the simplest solution. The main shafting in the mechanics' and meter repairing shops, driven from the main pulley of a gas-engine, runs along the front line of the building; and from this the various tools are driven in the ordinary way by belting, &c. From a main rope pulley on this at the north-west corner of the mechanics' shop a



PORTWOOD GAS WORKS — Make 750,000 Cu Ft Daily — 1890.
MILLGATE GAS WORKS — Make 250,000 Cu Ft Daily — 1892.
" " " — Converted into an Electric Light Station. 1898.
HEATON LANE GAS WORKS — Make 1,000,000 Cu Ft Daily — 1907
One Holder has been increased by Two Additional Lifts

PLANS SHOWING THE EVOLUTION OF THE PORTWOOD (STOCKPORT) GAS-WORKS—EVERY FIVE YEARS, 1890-1910.



THE WORKSHOPS AT THE PORTWOOD (STOCKPORT) GAS-WORKS.

drive is taken to a countershaft working at one side in a wall box, and at the other end in a bearing attached to the main joist of the travelling crane. Upon this are fixed two rope pulleys which continue the drive on to another and similar arrangement, and from that on to the main shaft in the carpenters' shop. Thus practically the whole drive is broken up into three sections, each taking up a comparatively small amount of space, allowing of short countershafts, and enabling the wall to be used for carrying purposes.

Sulphate of Ammonia Manufacture.

In the same year (1895) it was decided to manufacture sulphate of ammonia, and the necessary buildings were put up in the south-west corner of the works and abutted on the river wall. They consisted of a still room, 21 ft. by 29 ft. 6 in. by 25 ft. 6 in. high, the roof formed by a cast-iron tank, 35 ft. by 28 ft. by 4 ft. 6 in. deep for storing liquor, and a sulphate store in which it was intended should also be placed the saturator. The steam-boiler was to be arranged for in the position along the river wall which has since been utilized for the works boilers. At the west end the building was fitted up with a coal-testing plant, chemical laboratory, photometer room, &c.

After the buildings were completed, however, the then Committee decided to sub-let the sulphate section to a contractor, who undertook to put down the necessary plant and work it at his own cost on a schedule basis. Nothing further than concentration was ever adopted, and even that only for a time; but the terms of the schedule have, up to now, been such as to make the Committee doubtful as to the advisability of working up the ammonia. The still room is in use as a yard fitters' workshop, and the saturator room as a store for heavy articles, valves, &c.

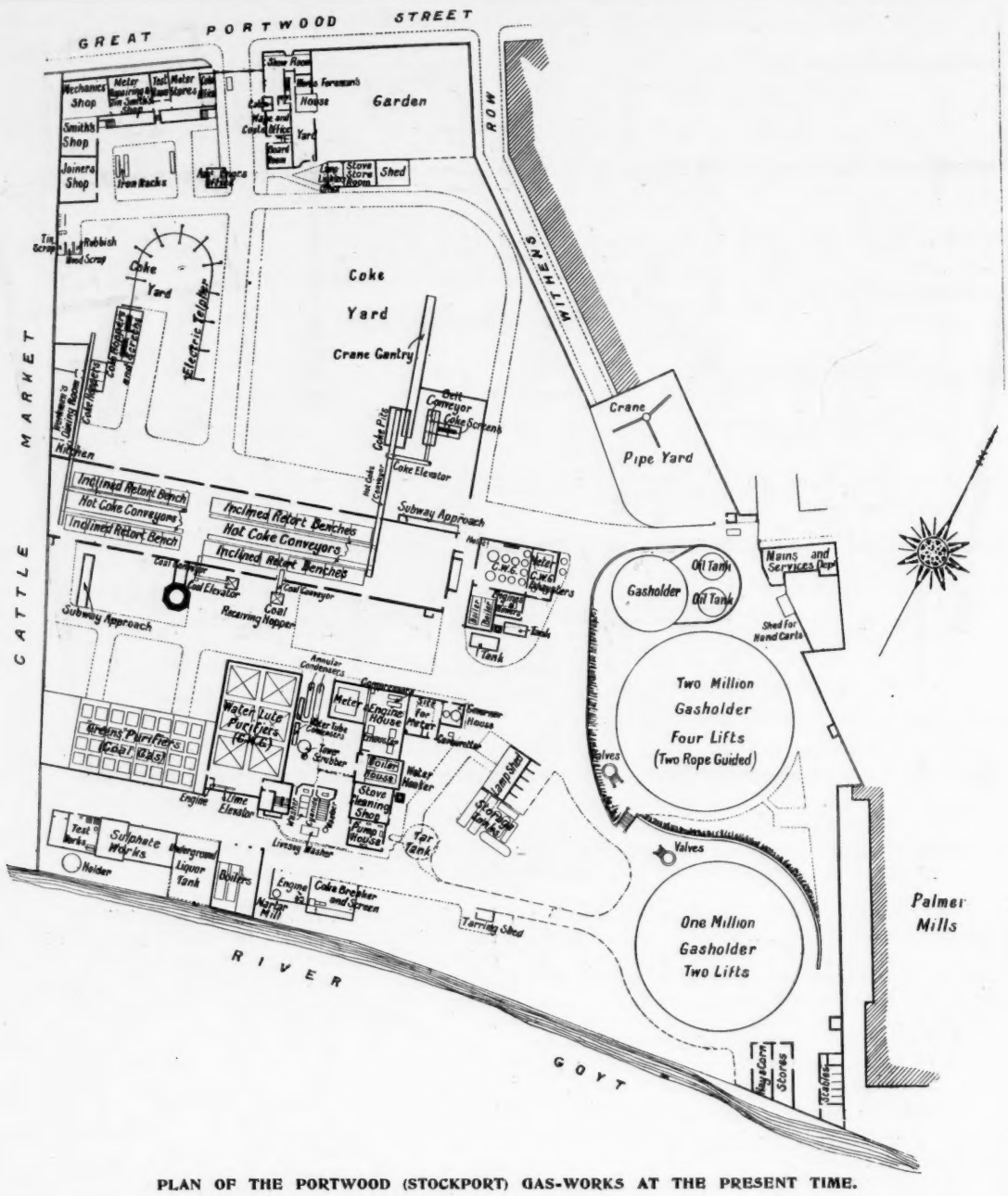
During the same year, the annular condensers, having been found to be of insufficient capacity, were extended by an addition to their length equal to double the area then available. A general plan of the works is given.

Carburetted Water-Gas Plant.

In 1896, further carbonizing extensions were found to be needed; and the question of whether these should take the form of additional retorts or whether carburetted water-gas plant should be installed was carefully considered. The fact that the former would materially encroach upon the yard space available for storing coke was its serious objection, in addition to which the adaptability of the latter for times of excessive or sudden requirements—always liable to occur in large mill towns—was a strong factor in the Committee's ultimate decision in favour of carburetted water gas. The various types of plant then on the market were very carefully investigated, with the result that it was decided to place an order with Messrs. Humphreys and Glasgow for one equal to a daily capacity of 500,000 cubic feet per day; space being left in the building for subsequent duplication, although boilers, pumps, fans, &c., were installed of sufficient capacity for both plants. The buildings were designed to allow for a curve of an elevated siding, which it was proposed should at some future time connect the works direct to the Cheshire Lines Railway. Space was also arranged for the re-fixing of the then coal-gas station meter, which it was ultimately intended to remove and use for carburetted water gas alone.

Relief Gasholder and Oil Storage.

A relief holder, on the Gadd and Mason principle, working in an above-ground steel tank, was included with the plant, together with two oil-storage tanks, each capable of holding 200 tons of oil. It may be remarked that these are placed at a different level from that of the generating plant—there being a fall of about 9 feet from the street level. The elevated ground formed a bank of filled-up material from the excavation of the No. 2 gasholder tank. The slope of this was replaced by a strong retaining wall built of Staffordshire brindled bricks topped with blue Staffordshire blocks. The concrete foundation of the tank, 5 feet thick, was excavated about a foot narrower at the bottom than at the ground line, so that the sinkage which was naturally to be expected might be minimized as much as possible by the wedge formation of the concrete acting on the sides of the excavation. As a matter of fact, 6 inches of settlement was calculated for; but the actual amount has been found to be barely 5 inches. A main used for pumping liquor to the railway siding, and running underneath the gasholder tank, was not removed, but was built round with 4½-inch brick walls covered over with tiles; so that the concrete has no bearing



PLAN OF THE PORTWOOD (STOCKPORT) GAS-WORKS AT THE PRESENT TIME.

upon the main itself, which has never leaked or given a moment's trouble. The two oil-tank foundations were dealt with in a similar manner.

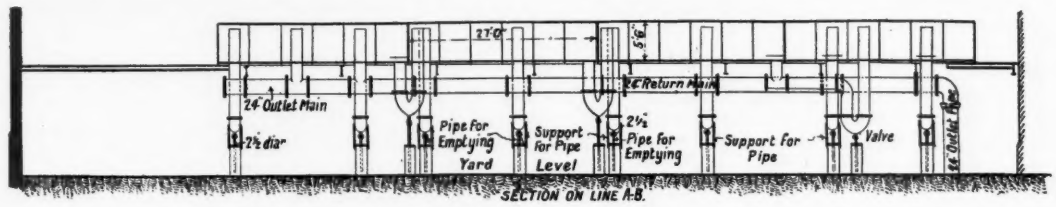
The oil-tanks are fed by gravitation from the railway sidings, about a quarter-of-a-mile away, through a 4-inch steel main; there being a clear available head from the bottom of the tank car to the top of the oil-tanks of over 6 feet, or a difference in level between the railway and the yard of 24 feet. Great care had to be exercised in running this main. All the joints (which are screwed) were made with yarn soaked in shellac, and pulled up with special tongs having handles 6 feet long. There has never been the slightest leak on this main since it was laid. It may also be noted that a brick wall, cement rendered, is run round the two tanks. This is of sufficient capacity to more than hold the entire contents of one tank; and the floor is arranged to fall to a small sump, which is connected to a 4-inch cast-iron pipe running out through the retaining wall, having a valve at the outlet end. This serves either to clear rainwater when gathered, or any oil which may have found its way into this reservoir from either the tanks or their connections.

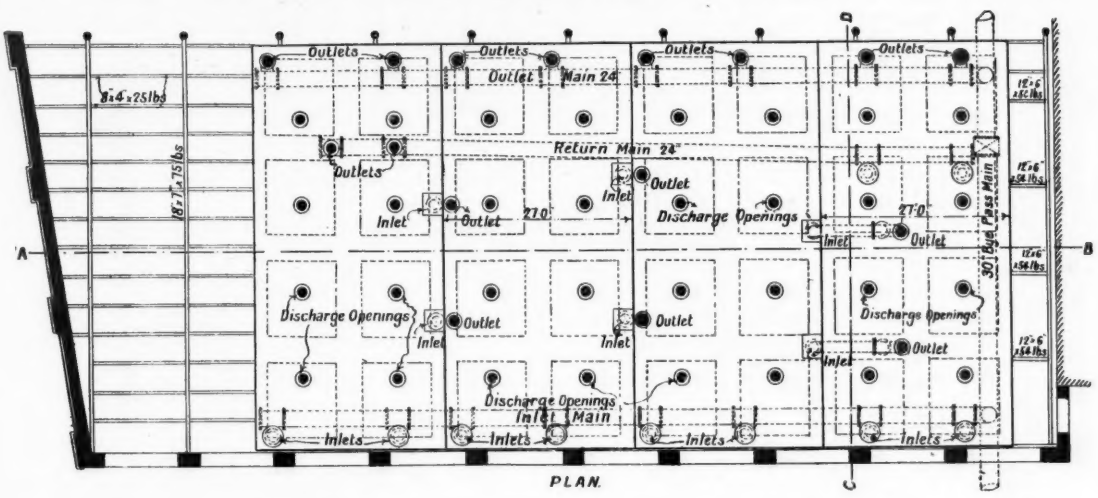
The original generating plant was ultimately duplicated; and subsequently, when the generator shells were badly corroded at the bottoms and new ones were required, it was found possible to replace them with two others, each of a nominal capacity of 750,000 cubic feet per day; so that the original plant of 500,000 cubic feet per day has since, on many occasions, turned out well over 1,500,000 cubic feet.

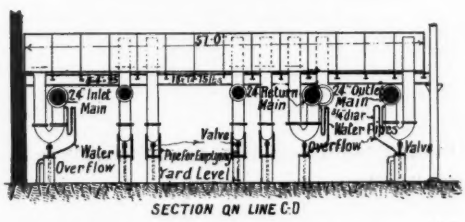
In 1896 also a separate meter for the coal-gas plant was installed—the other not being of sufficient capacity for both carburetted water gas and coal gas. A new meter house was accordingly built on the west side of the existing exhauster house, with which it forms one building—a portion of the original side wall having been cut out, and a strong arch turned. The station meter, equal to 3,000,000 cubic feet per day, which was afterwards installed (in 1898), faces into the exhauster house; and the width of the archway and space left clear is sufficient to enable the drum to be taken out and repaired or renewed by the removal of the front plates of case alone.

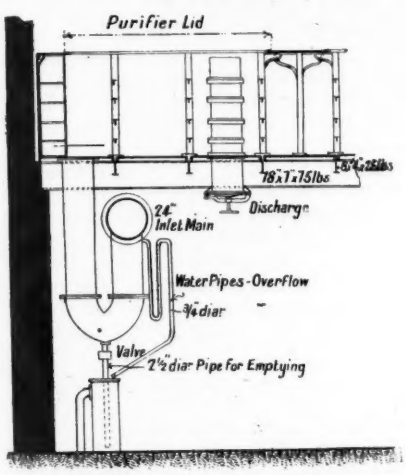
Gasholder Extensions.

The storage capacity of the gasholders was then taken in hand; and after very careful investigation and consideration it was decided to add two lifts to the No. 2 holder, working on the rope-guided principle. A contract for this was placed in the hands of Messrs. Ashmore, Benson, Pease, and Co., Limited, the special feature of which was that the entire work was carried out without emptying the tank. The columns only having girders at the top, special cast-iron clips were fixed halfway to carry an additional row of lattice girders; the whole being then cross-braced with strong tie rods. The next step was to

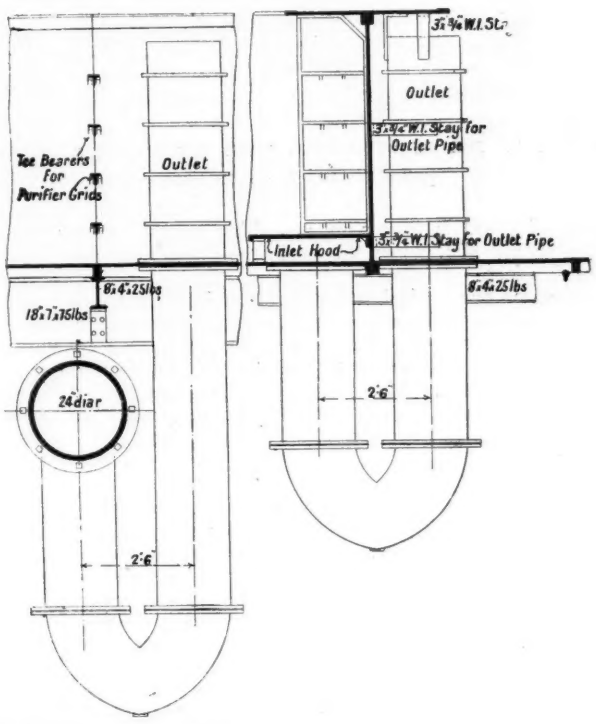








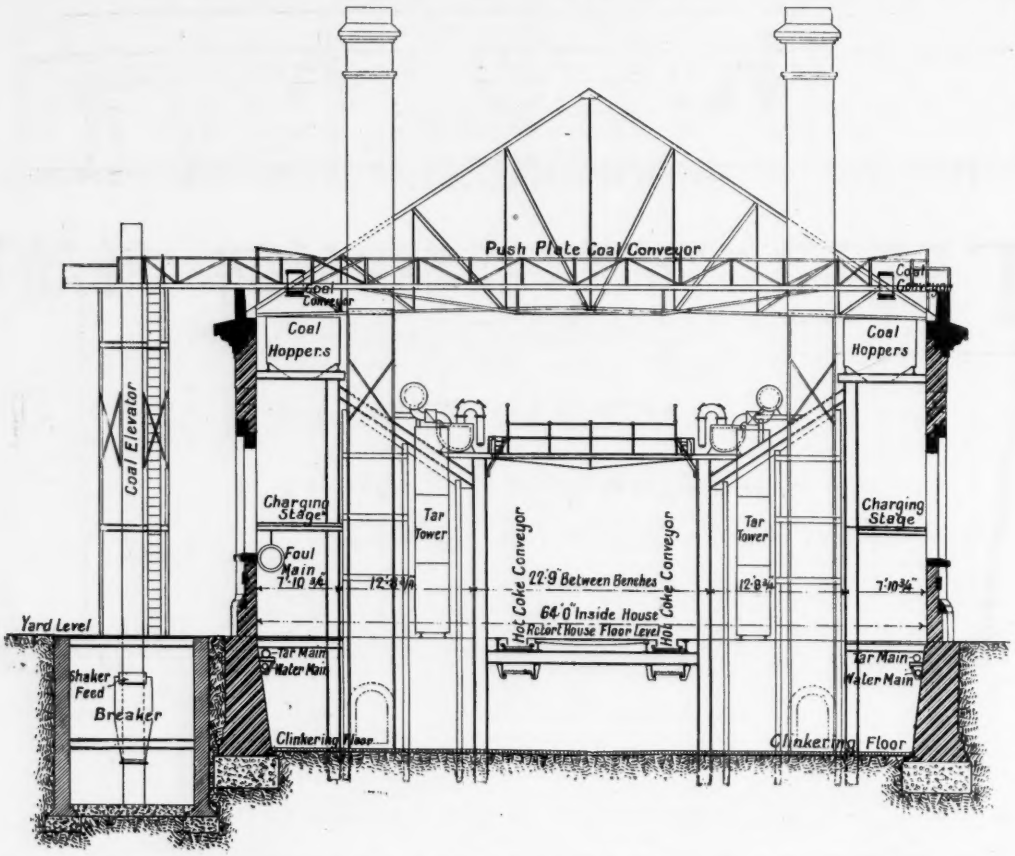
The Supports to the Top Plates.



DETAILS OF THE PURIFIERS.

remove the crown sheet over the end of each main truss bar. Two 9 in. by 3 in. timbers, having flat plates 4 in. by ⅜ in. bolted on the outer sides of each, were then fixed to the ends, and the diagonal bracing was attached to the top of the timber post and again to a special angle ring on the centre pipe. The crown sheets mentioned above were riveted on again, and the holder inflated to the cupping point of the second lift, with the timber posts suspended from the main bars. The linked tension rods and the diagonal bracing were then attached to the foot of each, the holder lowered, and about 4 ft. 6 in. of water taken out of tank. The main tension rods from the foot of the timber posts were then adjusted.

It may be mentioned that at the foot of each upright was placed a cast-iron shoe, made to work on a swivel, so as to adapt itself to any irregularity of the dumpling. The ¾-inch diameter rods running from the top to the bottom of each alternate member were then adjusted, the second and third rows of crown sheets removed, and 12-inch by 4-inch cross timbers from the top of each upright to carry the secondary bars were fixed. Special clips were provided and fixed to the vertical posts for securing the ends of the main tension and bow-string rods, which were afterwards cut away from the top curb. The trussed framing was next detached from the top curb, the top curb and two rows of side sheets were removed, and the main and secondary bars shortened to the required smaller diameter. The erection of the new lifts was then proceeded with in the usual way above water; the whole being afterwards lowered with all the guide carriages and channel guides fixed in position. The new top curb was then fixed, and two new rows of crown sheets connected up to the existing ones. The first row of side plates attached to the top curb is continued up 3 inches higher than the angle curb itself; and where the columns come, an opening is left for the water to run off, and at this point only. These projecting plates are intended primarily to be an



SECTION OF THE RETORT-HOUSE, WITH THE INCLINED RETORTS AS ARRANGED FOR THE EXTENSIONS IN 1910.

[Other details of the 1905 Extensions appeared in the "JOURNAL" for April 9, 1907, pp. 87-90.]

additional safeguard in case a man working on the crown of holder should slip, when the projection would act as a stop for his feet.

The extension has worked satisfactorily, and the maintenance has been very little, while the stability of the holder has been proved on many occasions. The great point as regards the ropes is to have them regularly and periodically examined and greased. This is done at Stockport every two to three months. The diameter of the bottom lift is 148 feet, and the height, when fully inflated, 120 feet.

PURIFIER EXTENSIONS.

In 1899, it was found necessary to increase the purifying plant, the boxes then in use being greatly overworked. Accordingly, the necessary buildings were proceeded with; the situation chosen being immediately in front of the sulphate buildings, and extending from the old purifier house to the wall of the cattle market. The construction is simple, and is practically formed of columns and girders—even the brickwork on the south side being really nothing more than strong brick piers with arches between, carrying one end of the roof principals; the intermediate filling being on the ground level a plain wall, and on the purifier floor level framed louvre boarding, which, in case of necessity, can be easily removed. On the north side, the roof principals rest on girders supported on columns.

The whole of the Portwood works are built upon the site of an old reservoir, and its difficulties as regards foundations may be easily realized when it is stated that in this extension an average depth of 14 feet was allowed for excavation; whereas good foundation was found in hard sand at 9 feet in some places, while in others it was necessary to sink nearly 20 feet—the depth varying between these figures to (say) an average of about 14 ft. 6 in.

There are four purifiers at present installed, with sufficient space for an additional catch box. Each of these is 57 ft. by 27 ft. by 5 ft. 6 in. deep, built on Green's principle. They are carried on 18 in. by 7 in. main girders, 75 lbs. per foot, and subsidiary girders 8 in. by 4 in. by 25 lbs. per foot. The latter are so arranged as to leave the joints of the bottom plates as clear as possible; the boxes themselves being strongly stiffened, more particularly at the sides, and having eight openings each, so as to allow for their emptying and filling. The material is dropped below by means of ordinary discharge openings having self-sealing lids. These openings are divided into four separate portions, one for each row of grids; and each section can be lifted out as emptying proceeds. In order to minimize the weight of the necessary mains upon the supporting girders, these were put in 24-inch diameter only, though the gas is fed to, and taken from, them by others of 30 inches diameter. The width of the purifiers being necessarily across the house, it was thought advisable to have double inlets and outlets in every box, so as to more evenly distribute the gas. The connections are so arranged that any number of boxes can be worked simultaneously, either singly or in rotation, and any one can be made the leading box; but the travel of the gas must be in one direction—that is, it would be quite possible to work Nos. 1, 2, 3, 4 or 2, 3, 4, 1, but not 1, 3, 2, 4 or 1, 4, 3, 2.

Valves are provided for by means of drop pipes with the **U** bend, at the bottom, which are to all intents and purposes water valves. The author originally intended to have these built into the purifiers themselves, so as to leave all the ground-floor space available for revivification purposes; but though a model was made which was found to work satisfactorily, yet, when the difference in cost was compared with the reduction in available ground space, it was thought preferable to instal the present arrangement. These valves are emptied when required through a $2\frac{1}{2}$-inch diameter pipe sealed in a square box connected by a 3-inch overflow with the main drain into the river. The boxes are made to serve a double purpose, as they form the base of an additional support to the water-valves, to which they are connected on two sides by strong 3 in. by 3 in. by $\frac{3}{8}$ in. **T** irons; so that from their concrete base to the mains above forms practically a column. The usual seal is 4 feet, regulated by a syphon overflow, $\frac{3}{4}$ inch diameter, open to the air.

There are special arrangements for the prevention of freezing in winter, as either exhaust steam from the various pumps in use, or live steam, can be turned on to each separate valve, which at the moment is filled with water. But little or no difficulty has been experienced in this direction. The method of filling the purifiers and elevating the material received very careful consideration. Various ideas were sketched out, and costs gone into; but the latter were always

found too great to allow of the usual elevating and conveying machinery being employed, having due regard to the capacity of the boxes and the number of changes required in the course of a year. It was found that the interest and sinking-fund charges in every case far more than counterbalanced any saving in working costs. It was ultimately decided to instal an electric motor of the same type as was in use at the Victoria Station, Manchester, for the moving of luggage, which could be used both as elevator and traveller. The rails, consisting of flat bars carrying the necessary current to, and returning it from, the motor, are affixed to and carefully insulated from the roof principals, which had been made sufficiently strong in view of the conveying plant having to be borne by them. The whole apparatus has been found not only efficient, but, owing to its low original cost, very economical in working. The only drawback is the speed of lowering, which, as the gear is worm-driven, is practically the same as the hoisting. Whenever replacement becomes necessary, however, this is a point which will not be overlooked.

It will be noticed by reference to the key plan that there is further available space on the north side of this building for another purifier-house of somewhat larger capacity than the present one, which, when erected, will complete the line of roadway passing in front of the meter, exhauster, and governor houses.

Stabling.

In 1900, it was found desirable to undertake a proportion of the department's carting; and as the tenders for the necessary stables, for some unknown cause, were all at an unusually high figure, it was decided to carry out the work with the ordinary works staff. The question of design and cost was again reviewed, with the result that hay and corn stores were erected, consisting of timber framing filled in with 4½-inch brickwork; the roof principals being covered with match boarding, on which the galvanized corrugated iron covering forming the roof is bolted. This has been found so economical and satisfactory that the same method was employed for the hay and corn stores, lamp lighters' gathering room, stove stores room, and stokers' mess room.

Additions to Condensing Plant.

In 1902, further additions were made to the condensing plant by the installation of two sets of water-tube condensers, which, as the space available was very small, had to be placed along the east side of the purifier-house, and between that and the old condensers. The overflow from both sets of condensers falls into a separator, the tar from which runs direct to the well; while the liquor passes through a series of pipes placed in a long shallow tank through which runs a stream of water, the quantity of which can be regulated as required. This was done to reduce the temperature of the liquor within working limits, as, owing to the small capacity of the well, this was apt to get much too high in the summer time.

Cyanide Extraction.

In 1904, it was decided to adopt Messrs. Chance and Co.'s process of cyanide extraction; and the necessary apparatus of tar extractor (Pelouze and Audouin type) and Holmes washer was installed. This was immediately followed by a Livesey washer, for the extraction of naphthalene—an evil which had been gradually growing worse year by year, and was at that period causing serious trouble.

Carbonizing Extensions.

In 1903, the question of replacement of the old original retort-settings, the benches of which had been working practically since the year 1877, had to be seriously gone into, with the view of arranging for the adoption of the most suitable modern system. Inclined retorts were erected in 1906-7. The great obstacle to be overcome was the extraordinarily large main flue, 7 ft. 6 in. by 4 ft. 6 in. inside, encased in a solid concrete bed and running down the centre of the old section of the building direct to the chimney. The impossibility of doing away with this—due to the comparatively short time it could be spared, and the difficulty of replacing it by any other available means without encroaching on valuable space—made it impracticable to replace the horizontal retorts by others worked by machinery, except by still adhering to the ordinary direct-fired furnaces, which was not to be thought of. This, then, left only the inclined system for consideration. Even for this it was extremely difficult to arrange for 20 feet retorts in the centre, while for shorter ones and double settings the question of temperature while working, and its possible effect on the men (the house being only 64 feet wide) was an important one.

Various methods of overcoming the difficulty were considered, and ultimately it was decided that an experimental setting should be erected embracing these ideas, and placed in such a position as to give the most thorough trial possible. This position is between the ends of the old and then latest benches. The setting was practically enclosed in front, so that any radiated heat was to all intents and purposes confined between two walls. The experiment was quite successful; and the Committee decided that the requisite extension, based on the results obtained, should be carried out. It may be stated that this bed, the retorts of which were composed of built-up tiles, worked five full seasons, and was only taken down to make room for the further extension of 1909-10.

In 1906, the first installation of these inclined retorts was proceeded with. The whole of the old horizontal settings, consisting originally of twelve settings of five 26 in. by 16 in. Ω-shaped retorts, were cleared away; the ground between the central mass of concrete and the outside walls of house excavated; and these lined with a battered brick facing bonded into the main walls at proper intervals. In these spaces the retort benches themselves were placed; the concrete surrounding the main flue acting as a buttress to the lower portion of the front, and the original openings into the main flue being utilized for the new settings. These consist of two benches on either side (or four in all) consisting of four arches each. They are 12 ft. 8¾ in. wide, horizontally measured from back to front, and allow of a retort length of 15 feet. Each arch, 14 ft. 6 in. span, contains twelve retorts, set in tiers of three each, Ω-shaped, 22 in. by 16 in. The charging and clinkering floors (top and bottom) are on the outside of, and the coke discharge floor between, the benches. The furnace doors are on the latter floor; the coke being fed direct from the retorts. The furnace is arranged in the centre of the bed of twelve retorts, which are practically divided for heating purposes into two separate beds of sixes by a 9-inch wall rising from the key-brick of the furnace arch to the underside of the main arch. The combustion chambers are placed in the centre of each section of sixes.

As the space in the basement between the retort-benches and the retort-house walls was too narrow for the men to properly clinker the fires, a small proportion of regenerating space was sacrificed, and a recess formed, equal to the additional space required for convenient working, by turning a strong arch between the pier walls of the benches.

These were the main engineering difficulties; but the question of radiated heat, especially on the discharge floor, remained to be dealt with. This was practically overcome by embedding in the front and back walls and arches of the settings 2½ inches of slag wool, and also fastening a thin iron plate on the inside of the mouthpiece lid and filling the space between this and the lid itself with the same material. As an additional precaution, a 4½-inch wall, with openings left to get at the dampers, sight holes, &c., was built up, lineable with the edges of the mouthpieces from the floor to above the level of the top mouthpiece. By this means, the author was enabled, without inconvenience to the stokers, to obtain 30-feet run of retort where previously only 20 feet was possible, and, further, by slightly reducing the size of the retorts and re-arranging the settings, to obtain a daily make of over 2½ million cubic feet on exactly the same space as originally produced only ¾ million cubic feet.

The whole of the benches are strongly braced; the top members being brought into use for carrying the tar, hydraulic, and foul mains; while the back of the hydraulic main itself forms a platform. A balcony has also been placed in front, to enable the ascension and H pipes to be easily and safely got at when required.

A balcony arranged on the outside of the retort-house was intended for the use of the men on the charging stage; but as it was only used for the storage of tools, &c., the insulation referred to was evidently sufficiently satisfactory with the ordinary ventilation through the window arches.

Breaking, Screening, Elevating, and Conveying Plant.

A full equipment of coal-breaking, elevating, and conveying, and coke-conveying, elevating, screening, and storing plant was at the same time installed, as shown on the plan; but as this was fully described in the Technical Press at

the time, the author does not propose to refer to it further, although he will be pleased to give any explanation and information that may be asked for.

The experience of this extension was so satisfactory that it was decided to extend the system to the eight beds of horizontal retorts erected in 1893. Accordingly, in 1909 these eight beds were removed, and two sections, each consisting of six beds of twelves, were placed lineable with the others, and with the same spaces arranged for both back and front. But as the main flue difficulty was not in evidence in this case, the lines worked upon were more orthodox as regards several points. For instance, the earth in the centre of the house was excavated, and the small main flue cleared away. The clinkering floor, like the discharging floor above, was placed between the settings; while the clinkering recess, and its consequent arch over the clinkering door to the first installation, not being required, its place was occupied by a main flue leading to a separate chimney at the end of each section. The only difference from the other plant is that the coal-elevator can, by a special arrangement of the conveyor, be used for either installation; while the coke-screening and storing plant differs to the extent that the coke-storage bunkers are entirely above ground, with patent self-opening and closing doors, and instead of the coke being emptied and stored by means of a travelling electric crane, this is done by telpher motor, now so much the vogue.

It may be stated that this method was very carefully considered for application to the entire work of dealing with the hot coke from this last installation. But it was found not applicable in the retort-house, in consequence of the small space available at either end of the benches, and the consequent sharpness of the curves. The same principle of longitudinal coke conveyors in front of the benches delivering into a cross conveyor at the end of the house—the latter working up an inclined plane outside the house and delivering into screens or storage bunkers as required—was therefore adopted. An additional door in the bottom of this conveyor, however, was placed at a suitable height; so that in case of necessity, such as special direct loading into carts, fire in the bunkers, &c., it could be opened, and the coke, as made, dealt with without going into screens or storage bunkers. A similar one has since been placed on the old plant, which is regularly used for loading the coke required for the carburetted water-gas plant. Self-opening and closing doors have also been adopted; so that now the whole of the emptying of the storage bunkers and the storing of the coke in the yard can be done by one man only on either the crane or telpher plants.

The whole of the mechanical driving is done by electric motors, the current for which is obtained from the corporation station by direct main (in duplicate) carried to a main switchboard, and then to the various motors. The price paid, based on scale, is about 0·75d. per B.T.U. Although the power required for various operations necessarily varies, it was thought more economical to instal all the motors as equal to the maximum, which in this case was 12 H.P.; so that, by keeping a spare motor on hand, the period of any breakdown could be materially minimized, while a comparatively small number of parts—and of a minor character only—would be needed. In addition, there is an avoidance of any possibility of incorrect fitting up of any motor.

Reinforced Concrete Liquor Storage Tank.

About the same period that this work was undertaken for the retort-house, it was decided to put down additional liquor storage tank, boilers, and boiler-house. These are situated on the river bank (the boundary wall of which was, after being raised, strengthened somewhat, cleaned, and repointed), and immediately adjoin the sulphate stores. The gable wall of this was taken down, and after the liquor-tank was completed, rebuilt upon the wall forming its west side. The liquor-tank was put in on the reinforced concrete principle, after very careful consideration of strengths, costs, and possible risks of leaking. The Kahn system was the one ultimately adopted. The walls, &c., are very light, being only 8 inches thick at bottom and 4 inches at top, while the tank is 19 feet deep. The reinforcement, however, together with the arrangement of buttresses and the tying together of bottom, sides, and tops, makes the whole extremely strong. As a matter of fact, although on completion it was left empty for a considerable time, and kept under daily observation, not the slightest sign of fracture or "giving" in any part was ever discovered.

The testing of the tank for leakage also was very carefully carried out. One or two leaks were found in the bottom (probably due to a little carelessness in rendering, or defect in the mixing of the concrete), which varied somewhat in accordance with the height of the river; but after being made right, and finding that the latter had ceased to create any effect, the tank was filled with water and left to stand—daily observations being made after the first week. It was found for a time that a small, but definite, loss took place, which was at last partially counteracted by floating dry and fine cement over the surface of the water. But a further difficulty then arose. There would be no diminution in level for a day or two, and then perhaps a drop of $\frac{1}{8}$-inch a day for several days, interspersed with variations from zero to $\frac{1}{4}$-inch each. After many attempts to elucidate the cause of this varying trouble, it was decided to coat the top of the tank with a hot mixture of thick tar and sand. It was then found that the apparent loss of water was stopped; but for a few days only. However, by a repetition of the process, with an ultimate addition of a further two coats, a complete cure was established.

Boiler-House and Boilers.

The boiler-house is an ordinary structure; the main features of the design being kept in accordance with the purifier-houses, sulphate-stores, &c. It contains two Lancashire boilers, each 8 ft. diameter by 30 ft. long, working at 160 lbs. pressure, and there is room for a third. They are sunk below the level of the roadway, which allows of the fuel being tipped clear on to the floor of the house. The steam ranges of the new and old boilers, including the carburetted water-gas plant, are direct coupled-up, and the pressure regulated by two reducing valves working the old exhausters and pumps at 60 lbs. and the carburetted water-gas plant at 100 lbs. per square inch. Dead-weight safety valves blowing off at these respective pressures are attached on the outlets of the reducing valves.

The chimney, made entirely of steel, is 100 feet high from the ground line, 8 ft. 3 in. diameter at bottom, and 5 ft. 3 in. at top. It has a fire-brick lining from the bottom to the top, and has an opening, with door, left in the foundation wall for cleaning-out purposes. A wrought-iron ladder is fixed on one side, as also strong hangers to the cap for the purpose of facilitating the annual painting.

Air Compressor.

The latest addition to the plant is an air compressor, to raise water from the 10-inch borehole sunk through the bottom of the works well, which was originally connected to the river by means of a tunnel. This borehole is 260 feet deep below the cellar floor, where the pump was originally placed, or 271 feet from the ground level, and the water is forced into a tank placed on a tower 47 feet above this, or a total height of 318 feet. The bore has a steel leader for a depth of 65 ft. 6 in., and for the remainder of its length is in the red sandstone measure.

Further Additions in Hand.

In conclusion, it may be stated that the following further additions are on hand—viz., two lifts for No. 1 holder; an elevated road from the back road into Longton Street round the carburetted water-gas buildings, and down the side of the retort-house; coke and pan ash washing plant; while the original 1891 installation of five beds has been cleared away and will probably be succeeded by vertical retorts, in which case the retort-house, as now existing, should be easily capable of a daily output of 6 million cubic feet.

Costs of the Extensions.

Appended is a sheet of costs for the various extensions mentioned, and an abstract of capital, revenue, and profit and loss accounts for the years 1891 to 1911, which, though not strictly applicable to the paper, the author thought might be interesting to some of the members.

Although not strictly applicable to works extension, it may be mentioned that in the year 1904 a steel high-pressure main was run to an outside district five miles away, which was extending at an abnormally rapid rate—the decision only having been arrived at after very careful comparison as to sizes of mains, cost of laying, and, above all, the possible complications in the narrow streets due to the direction of route a low-pressure main would have to take. It was found that the high-pressure system was not only no more costly (even including the compressors), but that it offered greater elasticity for future extension.

The compressors are of the Ingersoll-Rand type, fixed in

Evolution of the Stockport Gas-Works.—Abstract of Capital, Revenue, and Profit and Loss Accounts. March 31, 1891, to March 31, 1911.

Year Ending March 31.	Outstanding Debt.	Revenue Account.				Profit and Loss Account.	Appropriation of Net Profits.	Memoranda.
		Income.	Expenditure.	Gross Profits.	Percentage Gross Profit on Loans outstanding.	Net Profit.	In Aid of Rates.	Price of Gas per 1000 Cubic Feet. In Borough.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.	
A 1891	149,533 4 0	68,473 4 6	52,166 11 3	16,306 13 3	10·90	7,527 4 10	7,527 4 10	2s. 6d.
B 1892	160,186 10 8	74,378 18 1	59,953 10 6	14,425 7 7	9·00	4,687 3 8	4,687 3 8	2s. 6d.
1893	169,538 4 8	73,244 13 10	56,772 16 1	16,471 17 9	9·71	5,677 16 2	5,677 16 2	2s. 6d. and 2s. 8d.
*1894	174,101 10 4	76,356 12 1	56,782 19 3	19,573 12 10	11·24	7,945 14 5	7,945 14 5	2s. 8d.
1895	170,619 16 0	80,213 7 3	52,076 0 8	28,137 6 7	16·49	16,315 18 4	16,315 18 4	2s. 8d.
C 1896	181,360 19 5	76,762 11 9	52,940 10 11	23,822 0 10	13·13	12,014 10 10	11,000 0 0	2s. 6d. and 2s. 5d., less 2½ per cent.
1897	200,429 7 4	78,630 5 5	54,192 18 11	24,437 6 6	12·19	12,999 2 8	10,300 0 0	2s. 5d., less 2½ per cent.
1898	212,868 16 1	80,053 16 2	55,390 7 1	24,663 9 1	11·58	11,639 0 6	10,300 0 0	2s. 5d., less 2½ per cent.
1899	214,059 15 3	83,444 12 7	59,425 8 2	24,019 4 5	11·22	10,169 1 0½	10,069 1 0	2s. 5d., less 2½ per cent.
1900	223,247 12 10	89,729 17 11	65,044 12 7	24,685 5 5	11·05	10,576 9 4	7,531 0 0	2s. 5d. less 2d.
1901	230,626 15 10	99,102 4 2	75,018 8 8	24,083 15 6	10·44	9,392 0 7	8,292 0 7	2s. 5d. and 2s. 9d., less 2d.
1902	233,161 2 3	96,836 8 5	71,070 19 1	25,775 9 4	11·05	10,477 4 6	9,377 4 6	2s. 9d. less 2d.
D †1903	238,098 7 2	97,442 16 4	70,196 11 8	27,246 4 8	11·44	10,035 6 4	8,935 6 4	2s. 9d. less 2d. and 10d. industrial purposes.
1904	239,147 6 8	103,172 5 9	70,785 4 11	32,387 0 10	13·54	14,923 6 3	11,200 0 0	2s. 9d. less 2d. and 10d. industrial purposes.
1905	249,601 10 8	100,629 17 6	72,213 14 11	28,416 2 5	11·38	11,020 11 5	9,000 0 0	2s. 9d. and 2s. 6d. less 2d. & 10d. industrial purposes.
1906	250,779 2 9	105,512 14 8	75,777 5 10	29,735 8 10	11·85	10,158 1 6	10,058 1 6	2s. 6d. less 2d. and 10d. industrial purposes.
E 1907	246,652 16 4	109,862 17 6	75,611 18 6	34,250 19 0	13·88	17,412 18 4	13,000 0 0	2s. 6d. less 2d. and 10d. industrial purposes.
1908	256,726 0 8	116,660 10 8	79,062 5 2	37,598 5 6	14·64	19,070 16 10	15,000 0 0	2s. 6d. less 2d. and 10d. industrial purposes.
1909	258,003 14 9	116,810 4 11	76,428 19 0	40,381 5 11	15·65	21,490 0 5	15,000 0 0	2s. 6d. less 2d. and 10d. industrial purposes.
F 1910	248,217 12 1	115,821 17 1½	74,744 11 1½	41,077 6 0	16·55	21,054 5 10	18,000 0 0	2s. 6d. less 2d. and less 1s. 1d. industrial purposes.
G 1911	236,401 2 11	122,111 8 4	76,178 1 5	45,933 6 11	19·43	26,192 2 3	19,100 0 0	2s. 6d. less 2d. and less 1s. 1d. industrial purposes.

£6000 working capital borrowed in 1897, repaid 1893, £1000; 1900, 1500; 1901, 1000; 1902, 1000; 1903, 1000; 1904, 500; £6000.

* Coal strike.
† Price of coal increased 75 per cent.

A—In December, 1890, stokers' wages increased and time-and-half for Sundays allowed.
B—Stokers' time altered from twelve to eight-hour shifts.
C—Meter-rents abolished from September quarter at a loss of £1000 per annum.
D—Differential discounts allowed on gas used for industrial purposes up to 10d. per 1000 cubic feet.
E—Loans equated interest charges also being direct.
F—Additional discounts as under came into force in 1909.
Over 500,000 cu. ft. but under 1,000,000 cu. ft. per annum 1d. per 1000 cu. ft.
Over 1,000,000 cu. ft. but under 2,000,000 cu. ft. per annum 2d. per 1000 cu. ft.
Over 2,000,000 cu. ft. but under 3,000,000 cu. ft. per annum 3d. per 1000 cu. ft.
Over 3,000,000 cu. ft. but under 4,000,000 cu. ft. per annum 4d. per 1000 cu. ft.
4,000,000 cu. ft. per annum, and upwards per annum 5d. per 1000 cu. ft.
Minimum price inside the borough, 1s. 3d. per 1000 cubic feet.
Minimum price outside the borough 1s. 6d. per 1000 cubic feet.
½d. in the 1s. allowed to automatic meter consumers.
G—In aid of Coronation festivities, £250 in addition to above.

Approximate Costs of Extensions.

		£ s. d.	£ s. d.
1890 to 1893	Per paper of 1894		38,905 0 0
1895	Workshops		3,900 0 0
1895	Sulphate stores, laboratory, &c.		2,020 0 0
1895	Enlargement of condensers		300 0 0
1896	Carburetted water-gas buildings and plant	9,500 0 0	
1899	Carburetted water-gas extension to plant	2,600 0 0	
1906	Carburetted water-gas enlargement of generators	1,450 0 0	
			13,550 0 0
1896–8	Meter-house and station meter		1,705 0 0
1896	Retort-house ironwork, &c.		531 0 0
1897	Additional lifts to holder		8,900 0 0
1899	Purifier-house, purifier boxes, and conveyor		7,900 0 0
1899	River wall		630 0 0
1900	Stables		200 0 0
1902	New offices		625 0 0
1902	Water condensers		500 0 0
1902	Hay and corn stores		220 0 0
1902–3	Experimental inclined retort-bench		1,060 0 0
1904	Cyanide washer and tar-extractor		1,300 0 0
1905	Alterations to Clapham washer		220 0 0
1905	Lamplighters' room, stove-store room		203 9 0
1905	Livesey washer		200 0 0
1906	Tar-extractor (carburetted water-gas)		200 0 0
1906–7	Inclined retorts		27,900 0 0
1907	Alterations to washers and tar-extractors		532 0 0
1907	Well sinking		275 0 0
1910–11	Underground liquor tank		935 0 0
1911	Boiler-house, boilers, and steel chimney		2,430 0 0
1911	Inclined retorts (second installation)		16,600 0 0
1912	Compressors for pumping bore hole in well.		390 0 0

the engine house, and capable of working up to 40 lbs. per square inch. The gas pumped by them passes to a reservoir on the works made of an old boiler; going thence by way of a pressure reducing or regulating valve to a shed placed in the district to be supplied, in which are fixed Reynolds governors (set to a pressure of 30-10ths on the outlet) into the 9-inch and 8-inch distributing mains during the heavy lighting hours. For the other periods the low-pressure main from Stockport has been found amply sufficient, and a constant pressure of 20-10ths at the shed is kept up by a Peebles governor set to that, and so regulated as to close with a difference between the outlet and the inlet of 3-10ths excess on the former. This avoids any special attention except for occasional oiling, cleaning, &c., as the starting or stopping of the compressors at the works suffices to bring the two sets of governors into action.

Discussion.

Mr. S. Glover (St. Helens): I desire to conserve as much as possible the time of this assembly, and shall waste no time in offering my hearty thanks to Mr. Meunier for the paper he has submitted, which he desires shall be discussed in the most open manner possible. Those who do not know Mr. Meunier, I desire to assure that he is not a thin-skinned gentleman, and if any new ideas be thrown out as to how he ought to have constructed the Stockport Gas-Works he will not take them amiss. I desire to thank him for, and congratulate him upon, the way in which he concentrated our thoughts on this long paper yesterday, in offering the *précis* he placed before us. We have asked some of our members in times past to give us a summary of their papers, and this summary has sometimes taken a much longer time, and been more distracting, than the paper itself would have been. But this was not the case yesterday. You will have heard either in Yorkshire or in Lancashire the assertion that neither fools nor children should judge of a job until it is finished. The reconstruction of the Stockport Gas-Works has been finished up to its present condition, and Mr. Meunier is ready for anyone to see it and to judge of it. Being a near neighbour of Mr. Meunier, I took the opportunity, which many others would have taken if they had had time, to visit the Stockport Gas-Works, as I thought this was the best way to prepare for reading Mr. Meunier's paper. I congratulate Mr. Meunier upon the excellent way in which he has laid out the works. I visited the works some 27 years ago, and felt even then what scope the man who followed the then Manager, Mr. Jacques, had to give Stockport an excellent gas manufactory.

I think this has been done. [Mr. Glover then went on to call attention to the plans accompanying the prints of the paper as distributed to the members. But, as these are not the illustrations given with our report, this portion of his remarks may be omitted.] I desire to ask Mr. Meunier just one or two questions by way of illustrating points which he does not seem to have conveyed quite to our dull grasp in these matters. I was somewhat disappointed to find that Mr. Meunier was still much hampered at Stockport by want of storage accommodation for coal, and that he is under the other disadvantage of not having a railway siding to his works. I think we should all be very interested to hear what he proposes to do in future, and whether he has considered the possibility of lowering the floor of his yard and providing a coal bin of very considerable capacity, which he could secure there by taking up his pavement, and making a tank bigger and more serviceable for the purpose than the one he has made on the edge of the river for his tar and liquor. I should like to suggest to Mr. Meunier and to the Stockport Corporation and everybody concerned that no selfish ends should block the scheme which Mr. Meunier had under his consideration for providing railway accommodation into the works, because I think for a huge town like Stockport to be in the hampered condition of having to convey by single-horse cart into the back of its works all the coals required is a very serious interference with its most economical and successful working. I hope Mr. Meunier will be successful at least in getting his proposed high-level road into the works, which I think would lend itself to the storing of a very much larger quantity of coal on the site without the manual heaving up of it from the yard level to the store-heap, which I saw going on, and which seemed very costly and out-of-date. It will be appreciated that Mr. Meunier proposes to continue with his completion of the Stockport Gas-Works by having a high-level road. I would ask him if he could provide accommodation for himself and his successors by having a coal-bin in the coal-yard. I was very much interested to observe that Mr. Meunier, in his reconstruction of these works, is providing for more storage accommodation for gas by extending his present holders by the addition of a new inner lift, and very ingenious methods are being followed to do this work while the water is still in the tank. The two large tanks being so nearly associated with each other, the larger one which is not being disturbed being on a higher level than the lower one which is being disturbed, Mr. Meunier considers it unsafe to take the water out of No 2, or the second one, which is under reconstruction. I have been in the same position myself, when the tanks were very much nearer together than these two are, when they were aërating the water, and providing for men to go inside. Mr. Meunier has described how the inner lift is going to be provided with legs inside to stand upon, which I think is very ingenious, and is being copied by modern ladder makers, who put an adjustable foot on ladders to give an even bearing for ladders. Mr. Meunier does not show how he proposes to extend the rest-stones for the additional inner lifts, which are shown in the diagram resting on an extended rest-stone. I think it is extended, because it is of a different shading, but in the paper he does not show to us how, with the water in the tank, he proposes to extend the rest-stone. Following the diagram, you will find the words "Sulphate Works" mentioned; and it is explained what it will be when there are sulphate works which do not exist at all. But there are the means for scientific young men to test the coal. Mr. Meunier is looking forward to the possibility of having to reconstruct the Stockport works again. He has formed an estimate of the retorting power he will be able to get into his house when he has reconstructed it on a more modern system—vertical retorts. I suggest to Mr. Meunier that he has very much underestimated the capacity of the works that he will be able to get in when he has adopted a better method of carbonization than the one he has at present.

The PRESIDENT: It may be that Mr. Glover, in his incisive style, has touched upon the points which have occurred to many of those who have had the advantage of reading this paper, as quite a number have, and it may be that he has so covered the ground that the queries he has put to Mr. Meunier include all that might be raised by other people. As you do not appear to be anxious to continue the discussion, I will ask Mr. Meunier to deal with the questions that have been raised by Mr. Glover; and if he knows of any particularly weak spot—and, if he does not, who does?—he might make a clean breast of it, and tell us all about it.

Mr. MEUNIER: As this is going to be a sort of duet or duel—I am not quite sure which—between Mr. Glover and myself, I apologize at the commencement for the fact that the diagrams do not satisfy him. I rather think that you must clear my shoulders of any responsibility in the matter, and place it on those of the gentleman who reproduced the plans. With regard to the capacity of the works, at present we have practically an output of 6,000,000 cubic feet per day, 4,500,000 feet of coal gas, and 1,500,000 feet per day from the carburetted water-gas plant. As regards the ultimate extension, I am not quite sure whether it is going to be verticals or whether it is not. Possibly, I may not have as much faith in them up to date as Mr. Glover. I rather think, if Mr. Glover does not mind, I will wait and see till he has reset his own lot.

Mr. GLOVER: I should like the word "reset" to be cleared up before we go any farther.

Mr. MEUNIER: Then I will not say "reset," but "renewed." I presume you will have to do something with your retorts when they get cracked.

Mr. GLOVER: Yes, at some future time, if that is what you mean.

Mr. MEUNIER: That is it, exactly. As regards the capacity we can get in this particular portion of the retort-house, of course Mr. Glover is far better advised than I am. What I put down was 1,500,000 to 2,000,000 cubic feet at the outside; but I may be entirely wrong. In any case, I am perfectly prepared to accept Mr. Glover's estimate in the matter. With regard to the possibility of having coal-stores in connection with the elevated road that I mentioned, there is an idea that we should put up some large coal bunkers, not so much for the sake of storing the coal, as for the sake of easy handling and labour saving. At present we have to have a number of our men in on Saturday afternoons and on Sunday to fill the coal-breaker and store the coals in the bunkers above; and it is hoped that by putting in a coal-bunker, probably in the reinforced concrete style, we shall be able to do away with these men coming in. As regards railway accommodation, we had that in our minds some years ago; but unfortunately we have ratepayers who live in the district, and who object to having lines laid across the main thoroughfare. We promised to work in the night, or do anything they liked; but they were sufficiently strong to bottle the whole question up, and now, I am afraid, there is nothing left for us but this overhead inclined road and the use of steam-lorries. This, I think, will materially reduce the cost, though the cost of carting is not so much as many would imagine. As a matter of fact, during the years I have been there, the average price for carting has not exceeded 3d. per ton, which is a very low figure. But they are big carts, and the coal is filled into elevated bunkers, and dropped direct into the carts. The distance is only a quarter of a mile; and when I tell you that one horse and cart will bring in something like 45 tons of coal a day, you will easily understand that the carting is not a very big item. Mr. Glover also asks about the extension of the rest-stones of the gasholder. It is a matter of very little difficulty, because, after all is said and done, in order to make perfectly certain that everything is sound, after the framing has been let down the services of a diver will have to be employed, and we propose to extend the rest-stones by his aid. It is quite a common arrangement; and I did not think it necessary to specify it in my paper, especially as I wanted to cut it short. I do not know that I have much further to say. It is rather a difficult thing to make up your own discussion; but I have done my best so far as that is concerned. In conclusion, I would like to say that for any faults, either of plans or anything else, you must excuse me, because you must all know the trying times we have been going through, and we have had our own little special worries in addition. I had little time to prepare the paper. It was really done in two sittings, and revised at a third; and some of the plans that I have here are not exactly those that I should like to have included. However, there it is. As I said yesterday, you can take it or leave it, and find fault as much as you like, and you have left it.

The PRESIDENT: I feel sure that it is a paper that many of us will refer back to in years to come, more particularly with regard to the details of dealing with specially difficult items. We have before us two other papers which are as fully entitled to your best consideration as any of those which have been submitted to us during the sittings. A wrong notion is sometimes brought into the minds of members when they take up the programme, and at one time I

used to have it myself, I confess. They say to themselves: "Tuesday, they are the big papers. Wednesday, well, I may go to one of them; but Thursday, that is simply filling up." Now, I assure you, it is nothing of the kind. When Mr. Brearley's and Mr. Glover's papers were relegated to to-day, it was with a distinct idea of drawing a large muster. Do not let me, in this one particular, on this last day, find that I have misjudged you, and made a mistake. We have raised in Mr. Brearley's paper a matter which is of vital importance to the industry at large. We have raised in Mr. Glover's paper a matter of very great interest to the Institution. These subjects are much akin; and I purpose to ask Mr. Brearley and Mr. Glover to read their papers, and afterwards we will discuss them together. I think if we do this, it will be in the interests of the two subjects and of the members generally.

SOME OBSERVATIONS ON THE EXAMINATIONS IN GAS ENGINEERING.

By THOMAS GLOVER, of Norwich.

At the request of the Council, the writer has pleasure in submitting for consideration some observations made during his tenure of office as Examiner to the City and Guilds of London Institute in Gas Engineering.

A discussion on the subject of these examinations may be of service in helping to form an opinion as to their present value to the gas industry, and possibly may assist, in some degree, to ensure that the technical education of men who may ultimately fill responsible positions shall be equal to modern requirements.

In the absence of any examinations for which the Institution is directly responsible, we may feel thankful for the good work done by the City and Guilds Technological Department. The annual examinations have been now, for many years, an incentive to both organized and individual study; and many members of the Institution of Gas Engineers have, in their younger days, been proud of their Honours certificate. It may even be said that they owe their present positions, in some measure, to the discipline and study which were necessary for successfully passing these and kindred examinations.

It is fitting to acknowledge at this point the friendliness, courtesy, and consideration for the wishes of this Institution shown by Sir Philip Magnus and his staff of the City and Guilds of London Institute.

A feature of the examinations which comes first for observation is the great range in the quality of the answers given by candidates. This is likely to be the case so long as anyone willing to pay a fee can enter without submitting to preliminary science examinations. To obtain a full technological certificate, the City and Guilds of London Institute require candidates to pass, in the advanced grade, certain science subjects, or to otherwise qualify in accordance with Rules 29 and 30 in the programme. An extract from Rule 29 reads:

> Instruction in science should precede instruction in technology; and candidates are expected to pass the examinations in science or art, qualifying for a full technological certificate before presenting themselves for the final examination in technology.

If it is desired to increase the importance of the test, and add value to the certificates given to those who pass the Ordinary and Honours grades examinations, it may be advisable to require candidates for the Grade I. (examination in "Gas Engineering"), to first pass elementary Science and Arts Department examinations in chemistry and mechanical engineering, and candidates for the final examination in "Gas Engineering" to qualify by first passing, in the advanced stage, similar science and art examinations.

The insistence of such preliminary qualifications could not now impose any great hardship on students, since the facilities for acquiring scientific training have been brought practically within reach of all. The adoption of some such course would level-up the quality of the answers given to the Examiner's questions, and would greatly lighten his task. For, in going through the papers, it is comparatively easy and pleasurable to examine the work of trained students as compared with the other kind.

The next observation is expressed in the first paragraph of the Examiner's report of last year. It reads:

> The answers to the chemistry questions show, on the whole, a good knowledge of this side of modern gas-works practice; but the power to satisfactorily draw an elevation or a section, of gas-works apparatus or plant is, in many cases, distinctly weak. Dip-pipes are frequently shown attached to hydraulic main covers without flanges; retort-settings are drawn without any idea of proportion or correct measurement; while the arrangements of the retorts sketched in many of the answers displays a lack of observation on the part of the students.

The second paragraph reads:

> It cannot be made too clear that students of "Gas Engineering" desiring to fit themselves to occupy positions of trust in connection with gas-works management must learn to sketch and draw neatly and accurately.

From these two paragraphs, it would be quite correct to come to the conclusion that the majority of students are better taught and are better qualified in chemistry than in engineering; and it cannot be entirely satisfactory to the Examiner when candidates succeed in passing who have evidently had very scanty training in drawing and in making careful observations and measurements of manufacturing plant and apparatus.

Something may be done by the Examiner himself to encourage candidates to give a more important place to engineering subjects. This the present Examiner has endeavoured to do, both by his reports and by the quality of questions set for the annual examination; and he is hopeful that, before he retires from office, he may see an improvement in the direction to which he has drawn attention, as he has already done in the understanding of some manufacturing questions.

The last paragraph in the 1911 report reads:

> Distinct progress is observable in the knowledge of naphthalene formation and its subsequent removal, also in the understanding of the difference between heavy charge and long period, as against light charge and short period, carbonization.

These notes may be brought to a conclusion by the expression of a sincere hope that the City and Guilds of London Institute examinations in "Gas Engineering" may long continue to serve an increasingly useful purpose in training men to fill responsible positions in British gas undertakings.

Mr. GLOVER: In addition to what I have said in my paper, you have under consideration the question of having a different class of examination for gas-fitters. It is really a question whether you ought not to have an examination for gas foremen. Evidently, from the nature of the answers given, there are a number of such candidates who present themselves, and the class of work is, of course, somewhat crude in certain respects, but no doubt very creditable if we knew the men who submitted the answers. Still it is of a distinct quality, as you would expect from foremen. I take it that our wish is to raise the quality of this annual examination, and make it more fitting for real students and those who are intending to be assistants. We have a large number of those who go in for the examination; and it is evidently filling an important place in their training, because it organizes their study, and the certificates have a value which is quoted when the candidates are applying for employment before committees. The results are always looked forward to with a great deal of interest, and the Technical Press pays considerable attention to the results of the annual examinations. In my report this year to Sir Philip Magnus, I have been able to say there is a gratifying improvement in the quality of the drawings and sketches, particularly in the Grade I. examination. This, I think, shows that my report last year has had some effect in calling attention to the need of better drawing and proportional sketches being submitted by candidates. There is a distinct improvement in the first grade, as I have said; but I am sorry to say there is not the same improvement in the second grade. Sketches of an elevator, for instance, except in one or two cases, were poor; and the sketches of the bracing of the setting of a retort-bench were distinctly weak. I was also gratified to find that there was fairly good knowledge of the use of concrete in the retort-bench. As showing how up-to-date the students are, there were one or two cases of knowledge of the Burkheiser process and of the Cheltenham coal-liming process in a greater number of cases. But it was rather funny to find that many of the students missed the chief point—that it was for the reduction of the sulphur compounds—and gave as the result unstopped pipes, larger makes of gas, and so on.

SOME NOTES ON THE EXAMINATIONS IN GAS SUPPLY.

By J. H. BREARLEY, of Longwood.

Examinations have never hitherto formed the basis of a paper to the Institution. The Council act as an Advisory Board to the City and Guilds of London Institute in the subjects of "Gas Engineering" and "Gas Supply;" and it seems opportune that the general body of members should be enabled to contribute their views on the subject. Five years ago the Council recommended for, and the author accepted, appointment as Examiner in "Gas Supply," in the advocacy of which as a separate course he had taken a lead. It is due to him to say that the post is practically honorary so far as remuneration is concerned; but there its honorary nature ends, for such an expenditure of time and thought is involved as can only be fully realized by those who have actually undertaken similar work. The author was obliged, having regard to his other engagements, to resign the position in 1911; and the Council had the good fortune to secure Mr. Walter Hole, of Leeds, as his successor. A report dealing with the work done by the candidates during the period of the author's examinership may be of interest, not only to members, but also to all those engaged one way or another training men employed in the district work of gas undertakings.

Much discussion has taken place as to the suitability of the course, and the examinations for the average type of gas-fitter, and rightly so. A man fully qualified in all the branches embraced in the syllabus is more than an average gas-fitter; and the scheme which has been drawn up by the Manchester District Institution of Gas Engineers specially for the education of the gas-fitter is entitled to careful and sympathetic consideration. Indeed, future experience may show the need for some further subdivision; but progress in education, as in everything else, is surest if characterized by the speed of the tortoise, rather than that of the hare. It would appear that one of the greatest difficulties from the City and Guilds point of view is that the Manchester Gas-Fitters' syllabus traverses largely the same ground as the present City and Guilds syllabus in "Gas Supply." If it is intended that the City and Guilds authorities should adopt the Manchester syllabus as a separate course, this point will doubtless require careful consideration.

The writer set the test questions and examined the papers during the four years 1908 to 1911 inclusive; and the number of candidates presenting themselves during that period, together with the results of examination, are as follows:

Year.	Ordinary Grade.	Passed.			
		First Class	Percentage of Total.	Second Class.	Percentage of Total.
1908	152	47	30·9	66	43·4
1909	235	58	24·7	81	34·5
1910	217	54	24·9	81	37·3
1911	339	105	30·8	132	38·9
Total	943	264	28·0	360	38·2

Year.	Honours Grade.	Passed.			
		First Class.	Percentage of Total.	Second Class.	Percentage of Total.
1908	41	8	19·5	19	46·3
1909	80	20	25·0	32	40·0
1910	93	23	24·7	37	39·8
1911	89	21	23·6	37	41·6
Total	303	72	23·8	125	41·2

During each of these years the writer made careful notes of the number of attempts at each question and the number of marks awarded. The personal element (the examiner's assessed value of each individual answer) obviously enters into these figures; but, this notwithstanding, they afford a very useful basis for ascertaining the degree of knowledge possessed by the candidates (taken in the aggregate) of the various subjects set out in the questions.

The greatest difficulty confronting an examiner is to make such a selection of questions each year as will enable him to arrive at a fair conclusion as to a candidate's knowledge of the whole subject. One has but to peruse the various subsections of the syllabus to realize the magnitude of this difficulty. It may be confidently said that in the result the candidate is not penalized. If thoroughly prepared, he should be able to answer satisfactorily eight out of fourteen questions, providing he is able to display the same perspicuity inside as outside the examination room. Candidates inefficiently prepared may be fortunate enough to "strike" a sufficient number of questions upon which they are able to show a fair degree of knowledge; but certainly no well-prepared candidate will meet such a list of "posers" as will prevent him from securing a diploma.

Under examination conditions many candidates fail to do themselves justice; and their true technical worth in practice cannot always be assessed by this means. That does not minimize the importance, however, of getting them to undergo systematic technical study.

In his capacity of examiner, the author recognized the need for developing the intelligence of distribution employees in many directions, to which scant attention had hitherto been given. As a consequence, some questions were set that were a little ahead, speaking in the aggregate, of the students' knowledge, though fully covered by the subject-matter of the syllabus. Such questions acted as useful missionaries; for an earnest student always prepares himself thoroughly in the principles and practice of previous questions. Even if no similar questions recur in subsequent years, the industry, and therefore the community, benefits by knowledge developed in this way, which is more important than the mere awarding of diplomas.

The object of the present paper is to show the educational strength and weakness of outside employees so far as can be ascertained from the data which the four years' answers provided. These examinations are merely the means to an end, which is to obtain a more highly trained body of men representing gas undertakings beyond the meter; and if the industry knows how well, or how ill, its aspirants after knowledge have equipped themselves on the various points of practice, it should furnish useful guidance for the future. The data are compiled from no less than 112 questions embracing nearly every phase of the syllabus, 56 of which have been set in each grade. These questions are set out in Appendix I. (Ordinary Grade) and Appendix II. (Honours Grade), together with the subsections upon which the questions are based, the number of attempts at each question, and the efficiency as determined by the aggregate marks awarded. Each year ten questions were set in each grade, of which the candidate was allowed to answer not more than eight. But to four of the questions alternatives were set, bringing the candidate's choice up to fourteen. For facility of reference, the questions in the appendices are numbered consecutively from 1 to 112.

ORDINARY GRADE.

The average number of questions answered per candidate is 7·1. As a number answered five or less, showing obvious unpreparedness, this must be regarded as satisfactory. Out of the total of 943 candidates in this grade, 498 attempted the full number of eight questions allowed.

This is the only course of its kind to which is attached an examination at which candidates from any part of the United Kingdom or its Colonies may sit. It is, therefore, the only one at present available for gas-fitters, and it is worth while to analyze the results of the questions from the standpoint of the gas-fitter. It must be concluded that by far the largest number of candidates at these examinations were, or had been, gas-fitters. For example, question No. 18 in the index column, which deals with the practical operation of fixing a wet gas-meter and the materials and tools used for the purpose, resulted in 299 attempts out of 339 candidates, or 88 per cent. Again, question No. 24, which deals with the operation of converting a water-slide chandelier to modern requirements provoked 287 attempts out of 339, or 85 per cent. Question No. 55 is essentially another gas-fitting question; and out of 152 candidates no less than 123, or 81 per cent., attempted the answer, with the gratifying result of an efficiency of 86 per cent. If another course for gas-fitters is instituted, it is bound to deprive the present Ordinary Grade course in "Gas Supply" of the bulk of its candidates, and it would not, in the author's opinion, be prudent to do anything in that direction without making the necessary modifications in the present Gas Supply syllabus, to prevent overlapping. Admittedly the present course is not altogether suitable for the employees of a private gas-fitting firm. They are not concerned with the laying of gas

mains and services, or the testing of meters, for example. On the other hand, such employees are usually required to do a great deal more than concerns gas lighting or heating appliances.

That the candidates in the Ordinary Grade have not only studied the syllabus, but also the possibility of any special inclination on the part of the examiner, is shown by the fact that the two most popular questions had part reference to gas-fires—viz., Nos. 44 and 56. Of the candidates sitting, 92 per cent. attempted each of these questions relating to gas-fires; and compliments were, quite unconsciously, paid to the examiner for his work in this branch of applied science!

During the four years seven questions have been asked in section 1, which relates to "Mains and Services," in addition to five alternative questions. On the whole, these questions have appealed largely to the candidates; for, allowing the question and alternative as a single choice, the average number of attempts reached 84 per cent., and the efficiency 63 per cent. As these questions deal chiefly with considerations of practice, it is exemplified that the artizan, rather than the theorist pure and simple, has chiefly patronized these examinations. In section 2, "Gas-Meters," four questions have been set in addition to two alternatives. The answers to questions 13 and 14, show that slot mechanism is not as well understood as are the ordinary constructional parts of a dry meter. It is somewhat singular, too, that 172 candidates should prefer No. 16, as compared with only nine candidates attempting No. 15. This may be taken as evidence that tuition by dissection of different classes of meters is somewhat wanting, as, indeed, of many other forms of appliances used for lighting and heating.

The chief points arising out of Nos. 20 to 25 inclusive, based on section 4, "Interior Fittings," are that, while house service governors and the need for regulating pressures are well understood, knowledge of the size of pipes in relation to requirements is somewhat wanting.

The answers to section 5 (Nos. 26, 27, and 28), dealing with the "Theory and Application of Luminous and Bunsen Flames," and section 6 (Nos. 29 to 36) "General Lighting," have only been dealt with by the candidates in a moderate way; the average efficiency of the two sections being only 55 per cent. The fact that sketches were required in the answer to No. 29 probably accounts for the preference of the candidates for No. 30, though the general instructions accompanying the questions state that sketches will enhance the value of an answer. Knowledge should be more widely diffused as to the effect of various surfaces on reflection and the amount of light reduction resulting from the use of various kinds of globes.

The moderate result of the answers dealing with points of maintenance and construction of incandescent burners may be exemplified as another indication of the need for tuition of the practical demonstration character, confirmation of which is further found in the comparatively small proportion of answers to Nos. 37 to 42 in section 7, "Outside Shop and Street Lighting." Considering the comprehensiveness of the question, the answers to No. 40 may be regarded as being encouraging, and as again demonstrating that questions of practice really commanded the greatest support from the candidates.

The four answers to questions in section 8, "Use of Gas for Heating Purposes," show that the candidates displayed an enthusiasm in this branch of gas supply that was worthy of better results. The percentage awarded to the answers is not up to the standard which the industry requires from its outside employees. Taking the number of attempts in conjunction with the efficiency, the results last year [1911] were, however, by far the most satisfactory.

Considering that gas-engines do not come within the practical purview of the general, but rather of the special, gas-fitter, the answers to Nos. 47 to 50, section 9, are fairly satisfactory. With regard to No. 50, the disappointing result was chiefly due to candidates wilfully or unconsciously misreading the question, which was designedly difficult for candidates not having had practical experience to answer. If central classes for gas-fitters become more general, as they ought, demonstrations of the construction, working, and repairs of the gas-engine would gradually improve the knowledge of this, as of other sections.

Questions 53 to 56 each embrace more than one section of the syllabus. No. 55 was not only attempted by a high proportion of candidates, but it also had the result of the highest percentage of marks in the Ordinary Grade.

HONOURS GRADE.

The average number of questions answered per candidate was 7·05, which is practically the same proportion as in the Ordinary Grade. Out of the 303 students examined in the four years, no less than 153 attempted the permissible total of eight questions. In the two grades, about 8500 answers have been prepared; and as these answers bear but a small relation to the amount of study involved in the systematic course of tuition or training necessary to adequate preparation, there must have been a substantial gain of knowledge to the industry by the initiation of a separate syllabus for "Gas Supply."

Upon section 1, "Mains and Services," twelve questions (Nos. 57 to 68) were based, including alternatives. The percentage of marks averaged 65; the answers being best when dealing with questions based on matters of common and old-established practice. The lowest average of marks for one question was 51 per cent.

Section 2, "Interior Fittings," and section 3, "General Lighting," may be considered together. In these sections 17 questions (Nos. 69 to 86) were set; and the resulting answers afford useful information of the strength and weakness of "Honours" candidates in this branch of the subject of Gas Supply. Question No. 69, which relates to the lighting of a workshop bench, was only attempted by 39 per cent. of the candidates, as was also the case with No. 70, which sought to ascertain the candidates' knowledge of gas-switch installations. Nos. 71 and 72 afford a striking contrast; the question involving manual work being given a decided preference. The answers to sections 2 and 3 indicate that candidates are weakest when theoretical considerations enter into the subject of a question. The best practice is undoubtedly that which is founded upon the best available theory; and if students who have prepared themselves more or less assiduously for an examination show decided weakness in any given direction, it is pretty certain that this weakness will be more pronounced among the general body of distribution employees who do not sit for these examinations. The answers to the alternative questions 76 and 77, relating to ventilation and hygienic conditions, provoked 80 attempts out of 89 candidates. The alternatives 82 and 83 and question 86 show that matters pertaining to the incandescent mantle have been fairly well studied, with the gratifying result that the percentage of marks obtained is relatively high. The results of questions 78 and 84, relating to gas compression, were far from satisfactory. Much improvement, too, is desirable in the theory and practice of illumination at different angles from various types of burners and globes, as shown by results of Nos. 80, 81, and 85.

In section 4, "Outside Shop and Street Lighting," four questions were set. It is somewhat remarkable that the whole of the candidates attempted No. 87 [1908] based upon the respective methods of lighting street-lamps. Again, the whole of the candidates attempted one of the two alternatives 89 and 90 [1911] bearing chiefly upon photometry. Speaking generally, candidates are not "strong" on the plotting of illuminating curves, as is shown by the small number attempting Nos. 90, 81, 85, and 110.

Ten questions (Nos. 92 to 101) were set in section 6, "Gas Used for Heating Purposes." Nos. 92, 95, and 97, dealing with various phases of water heating by gas, were only attempted by 49 per cent. of the candidates, who secured only 45 per cent. of the total marks possible, clearly showing the room for improved tuition in this direction. During the last year or two, there has been a praiseworthy endeavour on the part of many undertakings to produce this improvement, in which endeavour makers of hot-waters appliances have readily co-operated. There have also been several pertinent contributions to the Technical Press; and no doubt future questions on heating water by gas will meet with a more encouraging reception. Quite a large number of those who did answer Nos. 92 and 97 went very much astray in the calculations necessary for the complete answer. Question No. 98, on the thermal efficiency of gas-cooking stoves, was evidently premature; for only 8 out of 93 candidates attempted it. This subject is now receiving greater attention—thanks to our electrical competitors. The questions relating to gas-fires, Nos. 93 and 96, and the alternatives Nos. 100 and 101, appear to indicate that candidates were better prepared to answer such questions in 1911 than they were in 1908; for whereas in the last-named year there was only an efficiency of 49 per cent., with 70 per cent. of attempts, in the first-named year [1911] there was an efficiency of 65 per cent. from 99 per cent. of attempts. This,

in the author's opinion, is useful evidence that the prominence which gaseous heating has occupied in recent years has, apart from other considerations, served a useful purpose educationally. May not some credit for the growing popularity of gas-fires be due to the better state of knowledge by distribution staffs?

The result of the questions Nos. 102 to 105 in section 7, "Gas Power," looked at solely from the point of view of these examinations is not satisfactory. Each year one question was set, with no alternative option of the (*a*) and (*b*) order. Attempts numbering 102 have been made by 303 candidates, or about one-third. The answers to No. 104 showed that those who attempted it thoroughly understood the repairs of a gas-engine; but that there was a total lack of knowledge of gas-driven electricity plants is evidenced by No. 105. Papers to the District Associations on the lines of the one contributed by Mr. Robert Wardell to the April meeting of the Eastern Counties Association would serve to extend knowledge of gas-engine theory and practice.

From the questions based on the remaining sections, the chief point to be gathered is that on matters of competition, whether for light or power, improved tuition or training is greatly needed.

The following extracts from the author's reports to the City and Guilds of London Institute contain the chief impressions formed from year to year of his examinership.

> 1908. This being the first year in which separate examinations in this subject have been held, the standard to be expected from the candidates was more or less hypothetical. In the event, therefore, it has been gratifying to find such a high degree of efficiency in the papers which have been submitted.
>
> Although the proportion of failures in the two grades is only 25·7 and 34·1 per cent. respectively, the large number of second class passes indicates that there is still room for more efficient preparation. The attention of Technical Institutions, particularly in the industrial centres, should be specially directed to the need for classes offering systematic training in the subject, conducted by duly qualified teachers. Considering the large number of employees engaged in the distributing branch of gas supply undertakings, there can be no doubt that such courses will be greatly appreciated, and will conduce materially to technical improvement in one of the most important branches of public service.
>
> 1909. This year the worked papers, even of the same grade, show enormous disparity in the qualifications of the candidates. While many of the papers which have secured a "first class" cannot be too highly spoken of, it is to be regretted that so many candidates present themselves who are obviously unprepared for an examination of this character. In the ordinary grade there were no less than 45 students, or 19 per cent., who obtained fewer than 30 per cent. of the total possible marks. There were 35 candidates who attempted fewer than six questions, while 37 of the others attempted six questions only. When it is remembered that the candidates had a choice of no less than 14 questions, all coming strictly within the purview of the syllabus, these figures indicate clearly the need for more systematic training. Most of these candidates must surely be denied the means of obtaining tuition by approved educational institutions, and the importance of extended provision for such candidates may be again urged on the education authorities of large towns.
>
> In the "Honours Grade" only 7 papers, or 8·75 per cent. of the total, obtained less than 30 per cent. of the possible marks.
>
> While there were few papers of marked excellence in the "Ordinary Grade," those which obtained first-class certificates in the "Honours Grade" were of a high order. In this grade, however, few candidates appeared to understand the use of squared paper for plotting illumination curves; and as the relative values of various competing forms of artificial illumination is a question of greater importance each year, a deeper study of this branch of gas supply may be usefully commended to candidates in this subject.
>
> 1910. It is again necessary to refer to the great difference in the quality of the papers submitted. There are a large number of papers which show either very inefficient preparation or poor tuition. The scope of the syllabus is so wide that only candidates who work assiduously throughout the winter months can reasonably hope to pass in the first class. There is a gratifying reduction, however, in the number of students who have obtained less than 30 per cent. of the total possible marks. The number of candidates, too, who have attempted six questions or less in the "Ordinary Grade" is smaller this year.
>
> The "Honours" students have shown a greater appreciation of the use of squared paper for plotting illumination curves. Many candidates waste time in writing matter which is not pertinent to the subject of the questions.
>
> 1911. It is pleasing to find that the quality of the work done in the "Ordinary Grade" has considerably improved. Only 34 out of 339 candidates obtained less than 30 per cent. of the total possible marks. It is quite evident that greater facilities for systematic training are being provided by educational institutions.
>
> It cannot be said that there is an improvement as compared with last year in the quality of the papers submitted in the "Honours Grade." The questions may have been a little more difficult than those set in the previous year; but the standard in this grade is naturally high, considering that there is no other examination test of a man's fitness for such responsible positions as that of district superintendent. Candidates for the "Honours Grade" should keep abreast of the latest developments in the way of research and invention, as described in the journals devoted to gas supply. It should also be remembered that if a first-class diploma is not easy to secure, it is all the more valuable.

Conclusion.

The general conclusion to be derived from the foregoing reports is that many candidates have presented themselves for examination who were inadequately prepared to give even a moderate account of themselves. The Ordinary Grade syllabus is certainly a somewhat large order for an ordinary gas-fitter, unless he is prepared to go to some trouble to master the subjects coming outside his usual working practice. Without committing himself to details, the author is of opinion that if classes for the practical training of gas-fitters were instituted, and the present "Gas Supply" syllabus altered to three grades, the end of a satisfactorily trained distribution staff would be ultimately reached. The benefits of some such subdivision would be enhanced by having a preliminary science course *adapted to the special needs of the gas industry*.

Alternatively, the Ordinary Grade might be divided into two sections, one embracing the gas-fitters' course, and the other treating of the remaining subjects included in the present syllabus. If this course were adopted, it would, he thinks, entail also the subdivision of the Honours Grade into two sections. Then a candidate might, if he chose, take only the section relating to gas-fitting, or both sections of the same grade in one year. A sectional certificate could be granted, or a complete certificate, for the grade according to whether a candidate attempted only the gas-fitters' section or the two sections embraced in one grade. This is merely put forward as a possible way of avoiding the syllabus overlapping already referred to.

As bearing upon this subject, the following letter which the author received in June, 1911, from an institution interested in the postal training of candidates for various examinations may be reproduced as giving the point of view of the "coach" on these examinations.

> We find that for the average student, the Ordinary Grade is much too difficult for working up in one season. The divisions from five to nine being more difficult than the other. The average student requires a good amount of arithmetic, and also a certain amount of elementary general science before he can touch No. 5, and parts of some of the other.
>
> As you will no doubt have noticed, there are a good number of fitters who now try for the examination, and they are not nearly fitted to take such a course. The students who are drawn from the assistants and other similar positions find the grade too easy in relation to the Honours. The gap is too great.
>
> With reference to the Honours Grade, this is practically impossible to the average fitter; divisions Nos. 5, 7, 8, 10, and 11 being the hardest. For the better students the grade might be even more difficult, as many students work through without much trouble.
>
> The best way to make the whole course more suitable would be to have three divisions. They might be called "Gas Supply" as at present, and then subdivided and called Preliminary, Ordinary, and Honours. The second one would be the standard for fitters and men in similar positions, and the Honours for those who will hold positions as engineers, distribution engineers, &c.
>
> The first course would not be worked by those who had passed "Gas Engineering," either Ordinary or Honours. The second not worked by those who had passed Gas Engineering Honours. The first course would have to be fairly elementary, and include some mathematics, and also physics. It might perhaps be even better to subdivide the course in the same manner as the "Electrical Engineering" course.

This letter is reproduced without comment, in order that the views therein expressed may be kept in view when the Manchester Gas-Fitters' Syllabus is under discussion. It is needless to add that the opportunity which the members of this Institution now have of discussing the subject may

also result in valuable suggestions for the consideration of the Council.

APPENDIX I.

Gas Supply Examinations—Four Years 1908-11 (Inclusive).

ORDINARY GRADE.

[The four numbers appearing in brackets after each question show: (A) Number of candidates; (B) Number attempting question; (C) Percentage of total; (D) Average efficiency by marks per cent.]

Section 1.—MAINS AND SERVICES.

Station and district governors. General principles of distribution. The various kinds of pipes and fittings used, and testing of same. Comparative advantages of wrought iron, cast iron, and steel. Methods of laying. Various form of joints and methods of jointing. Maintaining supply during alterations to existing mains and services. Causes, preventives, and methods of dealing with corrosion and deposits. Unaccounted-for gas. Causes of and testing for leakage. Syphons. Valves. Pressure-gauges. Maintenance.

No. 1.—1908. No. 1.—Of a service 100 yards long, the first 50 yards are laid with a total fall of 5 feet, and the remaining 50 yards with a rise of 8 feet. What provision is necessary to ensure a satisfactory supply? If the pressure at the main is 2½ inches, what will it be at the end of the service, ignoring frictional losses? [A 152, B 119, C 78, D 61.]

No. 2.—1908. No. 7 (*a*).—How would you carry out the operation of fixing a T branch in an existing gas-main (*a*) with, and (*b*) without, stoppage of the flow of gas through the main? [A 152, B 88, C 58, D 69.]

No. 3.—1908. No. 7 (*b*).—Describe two forms of low-pressure gas-main joints, and explain their relative advantages and disadvantages. [A 152, B 59, C 39, D 73.]

No. 4.—1909. No. 6—Describe fully (*a*) the cause of drawn lead joints, (*b*) the method of preparing and the tests to be applied to a cement mortar for gas-main joints, and (*c*) the means you would adopt of demonstrating to a consumer that the pressure of gas at his meter inlet is always adequate for his requirements. [A 235, B 140, C 60, D 49.]

No. 5.—1909. No. 8 (*a*).—Give sketch in section of a station governor, and explain how the pressure in the district is controlled. Describe the construction of the valve you consider most suitable for use with governor connections. [A 235, B 128, C 54, D 61.]

No. 6.—1909. No. 8 (*b*)—What are the considerations that determine the employment of district governors? Explain, by the aid of a sketch in sectional elevation, the use of a differential district governor. [A 235, B 76, C 32, D 59.]

No. 7.—1910. No. 1 (*a*).—Describe one form of leakage indicator suitable for locating escapes from gas-mains. A gas-main, 200 yards long, supplies 50 consumers and is connected to the distribution system at both ends; how would you ascertain the amount of leakage (if any) from same? [A 217, B 65, C 30, D 52.]

No. 8.—1910. No. 1 (*b*).—Describe fully the operation of temporarily stopping the leakage from a split 8-inch main, permanent repairs being impossible for some days. [A 217, B 139, C 64, D 61.]

No. 9.—1911. No. 1 (*a*).—An escape of gas being detected passing along the inside of disused drain, gas, or water pipes, how would you trace it to its source? [A 339, B 193, C 57, D 56.]

No. 10.—1911. No. 1 (*b*).—How does temperature and atmospheric pressure affect the item "unaccounted-for gas?" A gas undertaking has 9½ miles of mains, 840 consumers, sells 8,760,000 cubic feet of gas, uses on works 190,000 cubic feet, and makes 11,500,000 cubic feet. What is the leakage per cent., per mile of main, and per consumer respectively? How may leakage be systematically reduced? [A 339, B 113, C 33, D 65.]

No. 11.—1911. No. 3 (*a*).—Show by sketch and describe a method, other than gas bags, valves, or syphons, of stopping the supply of gas during mainlaying operations. State, with reasons, your opinion of its utility. [A 339, B 70, C 21, D 66.]

No. 12.—1911. No. 3. (*b*).—How would you proceed to clear mains obstructed by (*a*) corrosion, (*b*) naphthalene, (*c*) water? [A 339, B 207, C 61, D 68.]

Section 2.—GAS-METERS.

Principles and construction of gas-meters, including slot and stop mechanism. Repairing and fixing of meters. Appliances required for and regulations governing official test of meters.

No. 13.—1908. No. 8. (*a*).—Describe fully the working of one form of slot mechanism as applied to a dry meter. Is there any difference between the slot attachments of dry and wet meters, and if so, in what respect? [A 152, B 16, C 11, D 66.]

No. 14.—1908. No. 8 (*b*).—Describe the construction and working of a dry meter with special reference to the mechanism by which the gas is registered. What are the chief points upon which accuracy of registration depends? [A 152, B 85, C 56, D 67.]

No. 15.—1909. No. 10 (*a*).—Explain the constructional features and advantages in use of any two of the following: (*a*) Macfie's governor meter, (*b*) Thorpe's discount meter, (*c*) Valon's stop meter. [A 235, B 9, C 4, D 62.]

No. 16.—1909 No. 10 (*b*).—What means are employed in wet meters for preventing "slow" registration? Give one method of maintaining an unvarying water line in wet meters. [A 235, B 172, C. 75, D 53.]

No. 17.—1910. No. 2.—A five-light wet meter brought from a consumer's premises is found to be registering 25 per cent. slow. To what causes may this be ascribed? How would you proceed to put the meter into a thoroughly satisfactory condition and to certify the result of the work by testing on completion? [A 217, B 161, C 74, D 51.]

No. 18.—1911. No. 8.—Describe the operation of fixing a three-light wet gas-meter. State the size of the connections, the materials and tools used, and the precautions to be observed to ensure a satisfactory supply, including accurate registration. [A 339, B 299, C. 88, D 70.]

Section 3.—PLUMBING.

Properties and compositions of various alloys, such as brass, gun-metal, &c., used for valves, cocks, gas-fittings, &c. Solders, their composition, preparation, and uses. Methods of soldering.

No. 19.—1910. No. 3.—State, in percentages, the composition of the following alloys and the influence which each component has upon the finished alloy: Brass, gun-metal or bronze, solder. In what way are two pieces of composition (lead) pipe joined by means of a blow-pipe, and what precautions have to be observed? [A 217, B 117, C 54, D 58.]

Section 4.—INTERIOR FITTINGS.

Description and size of pipes in relation to requirements. Distribution of light. Testing of installations. Anti-vibrators. Movable pendants. Other fittings and accessories. Simple principles of ventilation. Method of governing pressure beyond the meter.

No. 20.—1908. No. 10.—In applying ventilating devices to living rooms, what general principles should determine the position of air inlets and outlets? In what way may gas be utilized to remove products of respiration above the breathing level? [A 152, B 90, C 59, D 63.]

No 21.—1909. No. 9 (*a*).—State the best form of movable pendant for (*a*) drawing room, (*b*) workman's bench. Give in each case the points of construction and conditions in use that determine your preference for the type selected. [A 235, B 113, C 48, D 64.]

No. 22.—1910. No. 4 (*a*).—Why is it desirable to have pressures at consumer's premises regulated? Describe, with the aid of a sketch, one form of house service governor. [A 217, B 105, C 48, D 76.]

No. 23.—1910. No. 4 (*b*).—How would you proceed to prove the presence of a leakage in the fittings of a consumer, the leakage being too small to be readily indicated by the index of the meter? [A 217, B 104, C 48, D 61.]

No. 24.—1911. No. 6.—Why is the use of water slide chandeliers considered inadvisable? Explain the operation of converting one with branches for three lights to modern requirements. [A 339, B 287, C 85, D 55.]

No. 25.—1911. No. 9.—What points determine the diameter of compo. pipe to be used for interior house fitting. Assuming an adequate service-pipe, with a gas pressure capable of maintaining 2 inches at extremities, give one example each of the use of ⅜-inch, ⅝-inch, ½-inch, ¾-inch, and 1-inch pipe. Give in each case the approximate length of pipe required, the burner (s) or appliance (s) for which it is intended, and the consumption of gas when in use. [A 339, B 130, C 35, D 49.]

Section 5.—LUMINOUS AND BUNSEN FLAMES.

Theory and application of.

No. 26.—1910. No. 5.—A room with 2000 cubic feet of air space is lit with one inverted burner consuming 3 cubic feet of gas per hour. What quantity of air will be required for combustion, and what will be the proportion by volume of its chief constituents? Assuming the air of the room is changed twice per hour, what percentage will the air required by the burner bear to the total quantity passing through the room? [A 217, B 54, C 25, D 47.]

No. 27.—1910. No 6 (*a*).—In practice, bunsen flames with luminous tips are met with. Give three cases, explaining in each the cause and the remedy to be applied. [A 217, B 118, C 54, D 69.]

No. 28.—1911. No. 4 (*b*).—Explain, with the aid of simple sketches, the best form of bunsen flame for (*a*) an upright incandescent burner of the "C" type, (*b*) an inverted burner of the Nico type, and (*c*) the boiling burner of a cooker hot plate. [A 339, B 59, C 17, D 50.]

Section 6.—GENERAL LIGHTING.

Construction of flat-flame, argand, regenerative, and incandescent burners. Regulation of gas and air supply to burners. Causes and prevention of mantle breakages. Influence of shades, globes, wall papers, &c., on light efficiency.

No. 29.—1908. No 6 (*a*).—Explain, and illustrate by simple sketches, what devices or means are employed in the construction of inverted burners for dealing with the products of combustion so as to prevent (*a*) deposition of soot on the mantle, (*b*) commingling with the primary air supply, and (*c*) impingement on the burner fittings or pendants. In each case give reasons why the devices are necessary for efficient results. [A 152, B 40, C 26, D 52.]

No. 30.—1908. No. 6 (*b*).—Explain the functions of (*a*) the ejector, (*b*) the cone deflector, (*c*) the mixing tube, and (*d*) the wire gauze or enamel burner head, as applied in incandescent burners. [A 152, B 64, C 42, D 63.]

No. 31.—1909. No. 4.—A series of empty rooms are each illuminated with (say) a 100-candle power inverted burner. The walls and ceiling of each room are papered or painted with one of the following colours: (*a*) Yellow, (*b*) black, (*c*) brown, (*d*) blue, (*e*) white), (*f*) chocolate. State in each case what percentage of the rays of light falling upon the surface of the ceiling and walls will be reflected. What is the influence of dirt on reflection, and to what approximate extent would it affect the reflecting power of a yellow paper after five years' use in a residence situated in a manufacturing district? [A 235, B 60, C 25, D 53.]

No. 32.—1909. No 5.—Describe the construction of one form of (*a*) upright and (*b*) inverted incandescent burner by means of which "lighting back" is effectually overcome. What effect has "lighting back" on the combustion of gas and its products? [A 235, B 185, C 80, D 55.]

No. 33.—1910. No. 7 (*a*).—State concisely the construction of ordinary types of (*a*) flat-flame, (*b*) argand, and (*c*) regenerative gas-burners. [A 217, B 57, C 26, D 62.]

No. 34.—1910. No. 7 (*b*).—In the maintenance of incandescent burners (inverted and upturned), what are the points to be observed to secure a low mantle account without sacrificing efficiency? [A 217, B 142, C 65, D 51.]

No. 35.—1911. No. 4 (*a*).—What are the constructional essentials of a good inverted incandescent burner? How do you ascertain when the gas and air are perfectly adjusted? [A 339, B 262, C 77, D 53.]

No. 36.—1911. No. 5.—What percentage reduction of useful light do the following types of globes effect when used with an inverted incandescent burner, (*a*) clear glass, (*b*) white opal, (*c*) clear engraved? How do reflectors affect the proportion of useful light, and what considerations determine their form and construction? [A 339, B 170, C 50, D 51.]

Section 7.—OUTSIDE SHOP AND STREET LIGHTING.

Types and construction of lanterns including burners and other fittings. Principles of windproof lanterns. Suspension brackets and lamp pillars.

No. 37.—1908. No. 9 (*a*).—Describe fully one form of wind and storm proof lantern, and show by sketch in sectional elevation how the wind proof efficiency is effected. [A 152, B 48, C 31, D 52.]

No. 38.—1908. No. 9 (*b*).—Give two methods by which the air of combustion is introduced into street lanterns, and discuss the merits of each. [A 152, B 26, C 17, D 57.]

No. 39.—1909. No. 9 (*b*).—Describe two forms of anti-vibrator suitable for street lanterns, state which you prefer, and why. In what way may rubber tube connections become disadvantageous? [A 235, B 91, C 38, D 66.]

No. 40.—1910. No. 10.—What are the common difficulties encountered in fixing brackets for outside shop suspension lamps, and the conditions which govern the position of such lamps? Describe, with the aid of a sketch or sketches, the operation of attaching a shop suspension lamp to the masonry above a window casement, and state the tools and fittings required to complete the work. [A 217, B 132, C 61, D 62.]

No. 41.—1911. No. 2 (*a*).—Dissect fully any 3-light inverted lamp with which you are acquainted. Enumerate and identify the parts with simple sketches, and explain the functions or purpose of each. [A 339, B 128, C 38, C 53.]

No. 42.—1911. No. 2 (*b*).—What constructional points are necessary to a good street-lamp governor? How may deficient governors affect the efficiency of incandescent burners? [A 339, B 114, C 33, D 51.]

Section 8.—USE OF GAS FOR HEATING PURPOSES.

Construction, types and fixing of cookers, boilers, fires, irons, &c. Hot water circulating appliances. Geysers. Flues for waste products.

No. 43.—1908. No. 5.—If you were called to a consumer's residence to remedy a faulty fireclay "fuel" (asbestos) gas-fire, how would you proceed with the work? What precautions are necessary in arranging the "fuel" in order that freedom from smell and high radiation efficiency may be secured? [A 152, B 133, C 87, D 49.]

No. 44.—1909. No. 7 (*a*).—Why is fireclay used for the fuel of gas-fires and for the lining of the back and sides? Which is usually the best method of connecting the flue pipe of a gas-fire to a chimney constructed for use with a coal-fire, and what are the principles that determine such a form of connection? [A 235, B 152, C 65, D 54.]

No. 45.—1909. No. 7 (*b*).—What is the cause of oven burners "smothering" out? What means would you employ for ascertaining whether there was deficient or excess ventilation—*i.e.*, air passing through the oven? [A 235, B 64, C 27, D 42.]

No. 46.—1911. No. 7.—You are sent to remedy complaints made by a consumer that (*a*) his gas-fire, with columnar fuel does not give sufficient heat, and (*b*) an objectionable smell is given off from the flame of his gas iron stand when the iron is being heated. Describe how you would proceed to remedy the cause of the complaints. [A 339, B 314, C 92, D 55.]

Section 9.—GAS POWER.

Construction and practice of the gas-engine.

No. 47.—1908. No. 4.—What are the chief points to be observed in the working of a gas-engine if economical running is to be ensured? [A 152, B 94, C 62, D 57.]

No. 48.—1909. No. 3.—Describe fully the cycle of operations that takes place in the cylinder of an "Otto" type gas-engine. If a gas-engine slowed down and finally stopped, how would you proceed to locate the fault? [A 235, B 167, C 71, D 60.]

No. 49.—1910. No. 8.—Describe the operation of starting a gas-engine, including the regulation of gas into cylinder after engine has been "overhauled." Which form of ignition tube do you consider most satisfactory, and why? [A 217, B 112, C 51, D 46.]

No. 50.—1911. No. 10.—A gas-engine user complains of porcelain ignition tubes breaking. Inspection shows the tubes to have been fixed correctly, they are of approved quality, and the ignition valve is in perfect order. What, in your opinion, is the cause of the trouble, and how would you proceed to remedy it? [A 339, B 84, C 25, D 25.]

Section 10.—TOOLS AND APPLIANCES.

A full knowledge must be obtained of all the tools and appliances necessary for repair and extensions from the works' governors to the point of combustion.

No. 51.—1909. No. 1.—Describe the following: (*a*) Ratchet stock. (*b*) Venturi tube. (*c*) A well-constructed gas-cock. (*d*) One form of thermostat. (*e*) Forster pipe joint. [A 235, B 41, C 17, D 31.]

No. 52.—1910. No. 9.—Describe the following: (*a*) Anti-pulsator. (*b*) Adjustable die stock. (*c*) Service cleanser. (*d*) Expansion gas-main joint (with sketch). (*e*) The operation of making a gas-main joint with lead wool. [A 217, B 139, C 64, D 55.]

Questions embracing more than one section.

No. 53.—1910. No. 6 (*b*).—How is efficiency best secured in the construction and use of (*a*) top burners of gas-cookers, and (*b*) gas irons? State the proportion of primary air to gas in a well-constructed bunsen, and the essentials of a good flame. [A 217, B 77, C 35, D 63.]

No. 54.—1908. No. 2.—Enumerate six distinct causes of insufficiency of supply to residences, and the remedies to be applied in each case. [A 152, B 139, C 91, D 58.]

No. 55.—1908. No. 3.—Describe fully how, on completion, you would test for leakage (*a*) the soldered joints of a gas-meter, (*b*) the joints of 6-inch gas-main, and (*c*) the soldered joint of an ordinary gas-bracket. State how the bracket is usually fixed, and show by simple sketches the tools used and the fittings required to complete the work. [A 152, B 123, C 81, D 86.]

No. 56.—1909. No. 2.—What are the advantages and disadvantages of gas and air adjusters as applied to (*a*) inverted incandescent gas-burners, and (*b*) gas-fires? What precautions should be taken in each case when installing inverted burners or gas-fires to ensure satisfaction in use to the consumer? [A 235, B 216, C 92, D 61.]

APPENDIX II.

Gas Supply Examinations—Four Years, 1908-11 (inclusive).

HONOURS GRADE.

[The four numbers appearing in brackets after each question show: (A) Number of candidates; (B) Number attempting question; (C) Percentage of total; (D) Average efficiency by marks per cent.]

Section I.—MAINS AND SERVICES.

Flow of gas in mains, theory and practice. Electrolysis and electric fusion. Pressures and pressure recording instruments. Main laying costs and relation to prospective income. First aid in cases of "gassing." High pressure distribution. Fans, blowers and compressors. Subways, advantages and disadvantages of. The carrying of mains over bridges, and under rivers and canals. Explosive mixtures.

No. 57.—1908. No. 10 (*a*.—By what methods may the pressure thrown by the gasholders be raised for the purpose of reinforcing the supply to the district mains or the distributing governors? Describe one of such methods as applied in practice? [A 41, B 26, C 63, D 62.]

No. 58.—1908. No. 10 (*b*).—A 6-inch gas-main is increased in length from 1200 yards to 3600 yards. What increase in the initial pressure of one inch is necessary to secure the same discharge of gas, and upon what formula is the answer based? [A 41, B 13, C 32, D 73.]

No. 59.—1908. No. 8 (*b*).—What tests would you apply to demonstrate the relative efficiency of various forms of lead joints in gas mains, bearing in mind common causes of leakage at such joints? [A 41, B 4, C 10, D 71.]

No. 60.—1908. No. 8 (*a*).—Describe fully the process of laying three 12-feet lengths of 8-inch gas-main, joints being made before dropping the main into the trench. What tools are necessary for the work? [A 41, B 35, C 85, D 78.]

No. 61.—1909. No. 2.—Diagram indicates the contour of road, distances and sizes of mains laid in the road, which is situated in an outlying district. At point A a 6-inch gas-main is joined to a 3-inch main, at point B the size is increased to 4 inches, and at point C it is again reduced to 3 inches. With the minimum draught on the mains the gas pressure at point B is 5 inches, but at maximum draft (for four calendar months in the year) it is reduced to six-tenths of an inch. For an approximate distance of 300 yards on either side of point B the supply is then inadequate for the consumers' requirements. Explain fully two remedies, state which you prefer, and why. The answer must pay due regard to first cost and cost of maintenance. A diagram accompanied this question. [A 80, B 67, C 84, D 57.]

No. 62.—1909. No. 5 (*a*).—What is the nature of the damage to gas-mains caused by electrolysis and electric fusion? What are the best preventives (*a*) in the case of existing gas-mains, and (*b*) in the operation of laying new mains? [A 80, B 51, C 64, D 59.]

No. 63.—1909. No. 5 (*b*).—What methods may be employed for connecting wrought iron services to Mannesmann steel mains? Show by sectional sketch the form of joint you would adopt, and give reasons for your preference. [A 80, B 28, C 35, D 60.]

No. 64.—1910. No. 1 (*a*).—Describe fully the operation of fixing a service clamp or clamps to a high-pressure main, and give sketches of the type of clamp or clamps you would employ. What tools and fittings will be required to complete the service connection? [A 93, B 63, C 65, D 75.]

No. 65.—1910. No. 1 (*b*).—Give sketch and description of a governor suitable for reducing the gas in a high-pressure main to normal pressure, and state the precautions necessary to ensure satisfactory working. [A 93, B 20, C 21, D 68.]

No. 66.—1910. No. 8.—The drawings are (1) front elevation (2) plan, (3) enlarged section at A.B. of the parapet which surmounts a railway bridge. Show by sketches in plan and section how you would carry an 8-inch main from point C in the highway to point D, and support it to the wall on side E of parapet. State, with reasons, what class of main you would employ, how expansion and contraction would be provided for, what specials would be necessary, and what tools and other material would be required to complete the work. Drawings accompanied this question. [A 93, B 74, C 80, D 55.]

No. 67.—1911. No. 6.—Ten tradespeople whose shops are approximately equi-distant in a street 400 yards long, apply for a supply of gas at 60 inches pressure to a total of 40 outside shop lamps. Present a scheme for same, including compression of gas, giving capacity of gas engine and compressors in duplicate, size and type of main, candle power and type of lamp, consumption of gas in engine and lamps per annum, and the maintenance charges for 800 lighting hours in the year. The compressing plant and main must be large enough to supply a further 80 lamps of the type adopted. [A 89, B 56, C 63, D 51.]

No. 68.—1911. No. 7.—What does "co-efficient of friction" mean, and what considerations are involved? Dr. Pole placed the factor for "co-efficient of friction" at 0·0060 for pipes, irrespective of dia-

meter. In what way has more recent research shown the factor to be inaccurate for certain diameters? Specify these diameters. [A 89, B 51, C 57, D 69.]

Section 2.—INTERIOR FITTINGS.

Specifications. Principles and construction of various types of burners and plant for intensified lighting. Lighting of churches, factories, and other large buildings. Theory and practice of ventilation by gas. Lighting for special purposes, such as billiard table, &c. Switch lighting.

No. 69.—1908. No. 9 (*a*).—In a workshop the greatest light intensity is required at a point 18 inches from the front of the bench, and an equal distance above it. Show by sketches in what position you would fix a low-pressure inverted burner of Nico type so as to obtain the greatest efficiency, and state the type of reflector you consider best for the purpose. [A 41, B 16, C 39, D 45.]

No. 70.—1908. No. 5.—What precautions are necessary when fixing and adjusting gas switch installations to ensure satisfactory results. Describe generally how you would carry out an installation in a church, and what provision you would make for extinguished bye-passes. [A 41, B 16, C 39, D 55.]

No. 71.—1909. No 1 (*a*).—[Plan of ground and first floors of a house were given. Candidate required to insert position for meter and certain fires, cookers, &c., and to indicate supply pipes.] [A 80, B 72, C 90, D 59.]

No. 72.—1909. No 1 (*b*).—[Plan of ground and first floors of a house were given. Candidate required to give specification of lighting arrangements with types of burners and consumption.] [A 80, B 2, C 2, D 54.]

No. 73.—1909. No. 4.—State the guiding principles of good school-room illumination. A schoolroom 20 ft. wide, 30 ft. long and 12½ ft. high contains separate desks for 12 students and a teacher. The desks are 2½ ft. high. What lighting arrangements would you employ so as to maintain an approximately even illumination of 2·5 foot-candles upon each desk surface, and what would be the number, c.p., and height from floor level of the light units employed? A simple sketch in plan must be used to show the relative position of desks and lights in the system adopted. [A 80, B 61, C 76, D 45.]

No. 74.—1910. No. 9 (*b*).—State generally how you would carry out lighting installations for any two of the following, having regard to the effect of artificial light on the eyesight: (*a*) dining-room, (*b*) brass finisher's workshop, (*c*) draper's shop window. What type of burners and globes or shades (if any) would you adopt in each case, and why? [A 93, B 58, C 62, D 67.]

No. 75.—1910. No. 10 (*a*).—What quantity by volume of carbonic acid and what weight of water is produced by the combustion of 1000 cubic feet of average coal gas? What volume per hour of carbonic acid, and what weight per hour of water, is given off by the respiration of an adult under normal conditions, and how many British thermal units of heat does he give out? In what ways respectively do the products of coal gas and the respiration of human beings affect the atmosphere of rooms? [A 93, B 20, C 21, D 50.]

No. 76.—1911. No. 2 (*a*).—Give sketch, in sectional elevation, showing what you consider the best arrangement of fresh air inlets and foul air outlets for a four-roomed house, two rooms on each floor, and state the points of construction and conditions upon which efficiency depends. The back and front rooms on the ground floor are assumed to be lighted from centre gas pendants, and those above from side gas brackets. Indicate the direction of the air currents. [A 89, B 45, C 50, D 61.]

No. 77.—1911. No. 2 (*b*).—Show, by sketch or sketches, how gas may be applied as the motive force for exhausting the foul air from rooms, and how such means may be applied to the ventilation of factories where large quantities of gas are used for gassing yarns, heating furnaces, or any similar industrial operation with which you are acquainted. [A 89, B 35, C 40, D 61.]

Section 3.—GENERAL LIGHTING.

Efficiency of flat-flame, incandescent, and other burners. Low and high pressure lighting. Theory, manufacture, composition, and testing of the incandescent mantle. Illuminating effect of different methods of lighting. Flame temperature. Air supply. The hygiene of gas.

No. 78.—1908. No. 7 (*b*).—Discuss the relative merits of compressing (*a*) gas, (*b*) gas and air, and (*c*) air only, in high-pressure installations. [A 41, B 7, C 17, D 26.]

No. 79.—1908. No. 1.—What are the principles which govern (*a*) the construction of the mixing tube of an inverted incandescent burner, including the size of its orifice, and (*b*) the shape of the inverted mantle? Explain the difference in the form of an inverted mixing tube and mantle when compared with the mixing tube and mantle of an upturned burner. [A 41, B 26, C 63, D 54.]

No. 80.—1908. No. 9 (*b*).—What proportion of the light rays from an upturned burner are radiated above the horizontal, and how is this ascertained? What means are adopted in street lighting for ensuring the greatest lighting efficiency on the road surface. [A 41, B 13, C 32, D 42.]

No. 81.—1909. No. 3 (*a*).—To upright burners of the "C" type an opal dome shade and a squat opal shade are fitted thus:—

[Illustration was here given.]

Show by curves the effect of the hemispherical illumination (*i.e.*, throughout a vertical arc of 180°) in each case as compared with the illumination given by the respective burners *minus* glassware. What is the relative effect upon the lower hemispherical intensity of (*a*) glass shades, and (*b*) metal ring and rods when used for the purpose of carrying reflectors. [A 80, B 21, C 26, D 35.]

No. 82.—1909. No. 9 (*a*).—What is the catalytic theory of the luminosity of incandescent mantles? What precautions must be observed in order to obtain the maximum luminosity from a given quantity of gas in a low-pressure burner? [A 80, B 20, C 25, D 59.]

No. 83.—1909. No. 9 (*b*).—How is the incandescent gas mantle made? What is its composition, and what is the effect of each component on the functions of the mantle? How would you test a mantle for efficiency and durability? [A 80, B 56, C 70, D 76.]

No. 84.—1910. No. 4.—Assuming either of the two following types of gas compressors are equally convenient for the lighting of business premises, which would you prefer, and why, (*a*) gas driven rotary, (*b*) hydraulic? If a compressor of the last-named type failed, how would you proceed to ascertain the cause and to remedy the defect or defects? [A 93, B 55, C 60, D 48.]

No. 85.—1910. No. 9 (*a*).—Give diagram showing the candle power at different angles below the horizontal of (*a*) any inverted burner and (*b*) any upturned burner each working at ordinary (say 2 inches) pressure and consuming not more than 4 cubic feet of gas per hour. A simple sketch in sectional elevation of each burner must also be given. [A 93, B 30, C 32, D 62.]

No. 86.—1911. No. 3.—What means have been employed to increase structurally the durability of incandescent mantles? Give sketch of form of ring support which you consider best for inverted mantles, and reason for your selection. [A 89, B 78, C 87, D 68.]

Section 4.—OUTSIDE SHOP AND STREET LIGHTING.

Public lighting. Testing for illuminating power and illuminating effect. Advertising and illuminating devices. Automatic lamplighting appliances.

No. 87.—1908. No. 3.—What are the relative merits of lighting street lamps by (*a*) torches, (*b*) gas bye-passes, (*c*) flashlights, and (*d*) automatic apparatus. [A 41, B 41, C 100, D 55.]

No. 88.—1909. No. 6.—Describe a method of automatically lighting and extinguishing street lamps in which pressure from the distributing governors does not form part of the operation. The appliance described must be adaptable to an inverted burner street lamp. The method of fixing to which must be fully explained, together with the precautions necessary for efficient working. [A 80, B 52, C 72, D 62.]

No. 89.—1911 No. 1 (*a*).—What general principles determine the efficient lighting of streets and public squares? Describe the means you would adopt for ascertaining the lighting efficiency of a public lamp. [A 89, B 76, C 85, D 55.]

No. 90.—1911. No. 1 (*b*).—How would you ensure accuracy when comparing photometrically the efficiency of incandescent burners? Describe the apparatus you would employ, and give examples of how you would present the results graphically. [A 89, B 13, C 15, D 56.]

Section 5.—INFLUENCE OF REFLECTION ON INDOOR AND OUTDOOR LIGHTING.

The reflecting powers of various surfaces and the means of ascertaining same.

No. 91.—1911. No. 8.—Describe an instrument suitable for ascertaining the surface brightness of wall papers, and its applicability for securing a correct distribution of light for general and special illumination. [A 89, B 21, C 24, D 60.]

Section 6.—GAS USED FOR HEATING PURPOSES.

Industrial and domestic uses of gas. Testing of heating appliances. The application of refractory materials to the construction of heating (and lighting) appliances. Influence of air supply and flame temperature.

No. 92.—1908. No. 4.—Upon what constructional points does the economy of a circulating water heater depend? Should the outlet be connected to a flue, and if so, what provision is necessary to avoid waste of heat by excessive draught? How many gallons of water should a circulating heater raise 30° Fahr. consuming gas of 600 B.Th.U. gross, at the rate of 30 cubic feet per hour? [A 41, B 30, C 73, D 44.]

No. 93.—1908. No. 6.—Assuming the following heating appliances have been fixed at a consumer's premises, (*a*) a gas steam radiator in workroom, (*b*) a register (basket) gas-fire in dining-room, and (*c*) a canopy gas-fire (with flue outlet) in bedroom, what respectively are the points upon which the consumer should be informed in order to secure hygienic efficiency at a minimum cost? [A 41, B 28, C 70, D 49.]

No. 94.—1908. No. 7 (*a*).—In what way does compression of gas affect the heat from, and the temperature of, a bunsen flame? How is the calorific value of gas ascertained? [A 41, B 32, C 80, D 65.]

No. 95.—1909. No. 8.—Give a list of the types (not makes) of gas wash-pans or boilers with which you are conversant. To what efficiency tests would you subject them when making a selection, and upon what constructional and other points would your preference for any particular one be determined? [A 80, B 35, C 44, D 52.]

No. 96.—1909. No. 10.—What are the constructional points to be observed in a gas-fire in order to effectively remove the combustion products? Show by sketch in sectional elevation, and describe what you consider the best means of conveying the products from the point of combustion to the point of discharge in the chimney of an ordinary fire-place. [A 80, B 74, C 92, D 60.]

No. 97.—1910. No. 2.—Show by means of sketch in elevation a circulating gas water heater, with the connections to compensating tank and a hot water radiator as used in heating public buildings. What fixing precautions are necessary when a complete installation is carried out? Give calculation of the gas required to heat by hot water system the air in a hall of the following dimenisons: Length, 150 ft.; width, 60 ft.; height to apex, 25 ft.; and to eaves, 13 ft.; assuming the rate of air change to be 5 times per hour, and the average increased temperature required 10° Fahr. [A 93, B 39, C 42, D 39.]

No. 98.—1910. No. 3 (*a*).—What tests should be employed to ascertain the thermal efficiency of gas cooking-stoves and the hygienic effect upon the air of rooms? [A 93, B 8, C 9, D 62.]

No. 99.—1910. No. 3 (*b*).—What are the advantages and disadvantages of flue pipes used in conjunction with gas cooking-stoves? [A 93, B 80, C 86, D 62.]

No. 100.—1911. No. 4 (*a*).—How is the radiation efficiency of a gas-fire affected by the composition and form of the "fuel" and by the manner in which it is fixed above the bunsens? How may the adjustment of the flame affect the percentage which the radiant energy bears to the total heat generated? [A 89, B 43, C 49, D 62.]

No. 101. 1911.—No. 4 (*b*) —State what you consider the chief advances in gas-fire construction during the last two years, as shown by the designs published in the Technical Press, and give the causes which have led to the modification you enumerate. [A 89, B 45, C 50, D 68.]

Section 7.—GAS POWER.

Calorific power. Comparative costs and thermal and mechanical efficiencies of the gas-engine, and competing power agents. Gas driven electricity plants.

No. 102.—1908. No. 2.—Describe two methods of governing the mixture of gas and air to the cylinder of a gas-engine. Which do you consider most satisfactory, and why? [A 41, B 19, C 46, D 59]

No. 103.—1909. No. 7.—What purposes do indicator diagrams serve in gas engine practice? Show diagrams, and explain the effect on the respective curves of (*a*) a contraction in the exhaust passages or an obstruction in the exhaust pipe, (*b*) pre-ignition, and (*c*) late ignition. [A 80, B 27, C 34, D 50.]

No. 104.—1910. No. 7.—A 10 H.P. gas-engine requires overhauling. Describe in detail the operation of taking off, repairing and replacing the valve box, gas, air and exhaust valves, piston and connecting rod. Why should a suction gas engine have an auxiliary supply of town gas? [A 93, B 34, C 36, D 73.]

No. 105.—1911. No. 10.—Draw up a concise specification for a gas driven electricity plant for supplying current to a 10 B.H.P. motor, 2 flame arc lamps, each rated at 1000 c.p., and 50 Osram lamps of 64 c.p. each. State the size of gas-engine required, the quantity of current absorbed per hour with all the installation at work, and the capital cost complete. [A 89, B 22, C 25, D 4.]

Section 8.—PHYSICS AND CHEMISTRY AS APPLIED TO LIGHTING AND HEATING.

The physical laws of temperature, radiation, conduction, convection, reflection, and refraction. The physical and chemical laws concerning diffusion and humidity. Instruments used for investigation, including spectroscopes, hygrometers, and thermoscopic appliances.

No. 106.—1910. No. 6.—(*a*) How may the variations of flame temperature be measured? (*b*) State briefly a method of estimating radiant energy sensible as heat from a gas-fire. (*c*) Why is a highly aërated bunsen flame hotter than a less aërated one? [A 93, B 61, C 65, D 51.]

No. 107.—1911. No. 5 (*b*).—Explain what is meant by the terms "diffusion" and "humidity." How are diffusion and humidity affected by the artificial lighting of rooms by gas and electricity respectively? [A 89, B 25, C 28, D 64.]

Section 9.

Gas in competition for light, heat, and power.

No. 108.—1911. No. 9.—With the best type of motor (20 B.H.P.) working continuously for 24 hours, give the quantity required of: (*a*) Town gas (600 B.Th.U. gross) in gas-engine, (*b*) Russian or American oil in oil engine, (*c*) anthracite in generator of suction-gas plant, (*d*) petrol in petrol engine, (*e*) electrical units for motor working from continuous current system. Give the thermal and mechanical efficiency in each case, and define what is meant by these terms. [A 89, B 32, C 36, D 35.]

Section 10.—STATUTORY ENACTMENTS, &c.

The general legal obligations affecting gas supply. The Factory and Workshops Acts, so far as they relate to the use of gas lighting and heating appliances, and the purity of the atmosphere in rooms. The relative fire risks of various illuminants, and effect on insurance rates.

No. 109.—1910. No. 10 (*b*).—Compare the relative fire risks of (*a*) town gas, (*b*) petrol air gas, (*c*) acetylene, (*d*) oil lamps, and (*e*) electricity. State what you know of the general effect of each on insurance rates. [A 93, B 42, C 45, D 57.]

Questions embracing more than one section.

No. 110.—1909. No. 3 (*b*).—Plot a light distribution curve of (*a*) an inverted gas-burner with which you are familiar, and (*b*) any filament electric lamp. Explain how the candle power has been ascertained. How may the results at any given angle be modified in the construction of the inverted gas-burner? [A 80, B 11, C 14, D 37.]

No. 111.—1910. No. 5 (*a*).—Give the equivalent of 54 in. of water pressure in pounds per square inch. (*b*) Define explosion and state the explosive limits of coal gas and air. (*c*) What is the law of the diffusion of gases? [A 93, B 74, C 80, D 63.]

No. 112 —1911. No. 5 (*a*).—(1) How may carbon monoxide be formed when gas is improperly consumed in lighting and heating appliances? (2) How is the percentage of carbonic acid in air ascertained? (3) Define radiation, conduction, and convection. [A 89, B 59, C 66, D 75.]

Mr. BREARLEY: I have received a letter from Sir Philip Magnus, in which he says:

I have read with interest the paper you have forwarded to me, which I understand is to be communicated to the Institution of Gas Engineers at their annual general meeting. I am very sorry that I cannot be present, though I doubt very much whether, if present, I could add anything of value to the discussion. I was not aware until I read your paper that the Manchester District Association of Gas Managers takes special interest in this subject. I shall be very glad to hear whether any recommendations are made by the Council of such Institution as a result of your paper; and I can only say that any recommendations will receive careful consideration.

Discussion.

The PRESIDENT: Gentlemen, you have now before you two papers—one submitted by Mr. Glover, the Examiner in "Gas Engineering," and the other by Mr. Brearley, the late Examiner in "Gas Supply"—added to which you have had the comments of Mr. Glover with regard to works foremen and the like. I feel certain we shall have an interesting discussion on these subjects. You will be interested to know that we have present among us to-day Mr. Hewitt, of Toronto. I wish to extend to him our hearty welcome. As we have him here, we will, true to our national instincts, make the best use we can of him by asking him to address to us a few words as to how they treat these things in his part of the world, as possibly what he has to say might throw some light on the question, before we get to close grips in the discussion.

Mr. ARTHUR HEWITT (Toronto): Mr. President and members of the Gas Institution, it is a great pleasure to me to be received in this way at your meeting this morning. I have been much interested in the matter, and, as President of the Canadian Gas Association, I should be able to gather some inspiration in enabling me to frame a paper to be read before our Institution at the end of August. Unfortunately, the gas industry in Canada is not very large, and what there is of it is in one or two localities. It may surprise you to know that in Toronto our output of 300 millions represents almost one-half of the entire output of Canada, due largely to the low price at which our gas is supplied. For these reasons, the education of the employees must necessarily be local, and we should take our men and train them after our own fashion—following, I am glad to say, very keenly the lines laid down by the gas engineers, from whom we are able to get a great deal of help. You may also be interested to know that when I suggested a certain line of policy with regard to particular points to the Vice-President and General Manager of one of the very largest American Companies, asking his opinion as to the relative advantages of the English and the American practice, he wrote me quite candidly to the effect that in a final analysis we follow the Englishmen. It is astonishing how the tendency is to follow the English. Being born in this country, and having left it at an early age, and having spent some twenty-five years with the Company I am with now, I have never forgotten that I am an Englishman; and it is my great delight to be among you to-day. If there is one thing in which I think the American system has advanced perhaps farther than most of the English companies have done, and along better lines, judging from the observations I have been able to make in the few days I have been here, it is on the commercial side of the gas industry. For instance, a little more than three years ago, or up to that time, the Company that I represent had been, as a good many of the English companies were at the time, selling gas to anybody who came after it. But as one speaker this morning has thanked the electric light companies for some things, we have had to thank them for certain business suggestions. The result is that we have to-day a very large percentage of the commercial lighting of our city. We have a condition to meet which most of you do not, and that is a gradual increase running from about 15 to 17 per cent. each month compared with the corresponding month of the previous year. I got this morning a memorandum of the results of a month, showing 15 to 16 per cent. increase in the output of the month of May. In the matter that has been particularly discussed this morning, we have to do our own educating. True, the American Institution, also following the Englishmen, has examinations which tend to show the class of the employees; but it has not been done on anything like the grand scale it has been in England, judging by the special reports which I have heard this morning. Mr. President, I am very proud indeed of this opportunity of being in the midst of so many gas engineers of such high standing.

Mr. GEORGE HELPS (Nuneaton): When I was at school, and I daresay when some of you were at school, it used to be the custom, which is different among men, to say, if you disagreed with a boy, that you would punch his head. I am not differing from Mr. Brearley this morning; so I hope he is not going to suggest that he will punch my head, and I certainly am not going to punch his. I wish, Mr. President,

to apply the schoolboy idea to this education question; and this is how I suggest it should be done. All who set questions should first of all know how to answer them; all who set up to educate, should be themselves educated. And this important matter of the education of gas-fitters, on which the industry relies at this moment more than on any other question before us, demands, in my opinion, that we should give it every attention, look well into it, and not be afraid to stand up and speak our views, as I sometimes am. I am strongly in favour of a Board of Examiners, and I will tell you just why. When I look at these questions that Mr. Brearley has set, I marvel that he has been able to set them; and I say this without any disrespect. When I look at the questions which are set in the Ordinary Grade, and which are passed by a large majority of those who sit for these examinations, I thank goodness that they do not ask me to answer them. I profess to know something about my work; but I do not know that I could answer these questions as they appear in the paper. I argue that every question that is set should be understood by the man who sets it. [Laughter.] I am serious. In these days of publications, in these days of literature, what is to prevent a man getting hold of half-a-dozen books and setting a few posers? I would undertake to give some of the gentlemen here some posers if I had some books alongside of me. How is this to be done? We must have practical men on the board. If we are going to teach a man gas-fitting, the man who sets the questions should have a gas-fitter alongside of him. Whatever the matter is, when they are setting out to examine, let them see that they have absolutely practical men—practical in every way. If we were to start out on this proposal of teaching gas-fitters, and we set them questions, and if they were set in this room, half would say they were answered wrongly, and the other half that they were answered rightly. Are we on the right lines? I say "No." Let us resolve our own opinions first into one opinion; let us get at the best possible base-line for the work we are setting out to do; and do not let us hurry in getting to that base-line. I hope, in conclusion, these expressions, however crudely they may have been put, may bring about some result on the Board of Education which I suggest should be formed.

The PRESIDENT: I should like to point out to Mr. Helps what a wonderful confirmation we have had, in the gas-fitters' scheme, of what he has suggested on the very point that he has so forcibly driven home—namely, the necessity for practical assistance. That has been provided for, and I believe very much from the assistance of Mr. Helps himself. So that for once we are in absolute accord with Mr. Helps. With regard to the examinations in both "Gas Engineering" and "Gas Supply," we are also in accord with him, because I think he would be the first to claim that our Examiners are the most practical men we have in this particular department in the whole industry.

Mr. HELPS: Then I am only sorry I have wasted your time by talking about something which you have already decided.

The PRESIDENT: I would claim your attention, gentlemen, to Mr. Browne, who has been one of the Examiners of "Gas Engineering," while he addresses the meeting.

Mr. A. F. BROWNE (London): This, Sir, is an important subject, and the papers that have been read are very valuable. I am exceedingly glad you have been able, as I know you very much desired it, so to arrange the somewhat unwieldy business of the meeting in order that there might be an adequate discussion upon this matter. I am exceedingly pleased to find that both the Examiners are in agreement with regard to a fundamental difficulty which is quite familiar to myself, having been at one time responsible for these examinations. It is pointed out very clearly, especially by Mr. Glover, who speaks of the great range in the quality of the answers given by candidates. Mr. Brearley speaks in 1909 of the enormous disparity in qualification, and in 1910 of the great differences in the quality of the answers. Mr. Glover assigns as the chief cause the absence of a preliminary science examination, and further the absence of subsequent progressive instruction in general science. Mr. Brearley appears to find a sufficient explanation of the difficulty when he speaks of insufficient preparation and poor tuition. I do not think he is referring to the professional tuition which candidates receive, but probably to that attempt at self-education which many men who are not well situated as regards technical training colleges attempt to carry on for themselves. I am very strongly of opinion that in such a matter as technical education it is hopeless for a young man to attempt to teach himself. We all of us know that self-education has been, and is even to-day, very fine moral discipline; but any young man who attempts it nowadays is hopelessly handicapped, and is infallibly left behind in the race for knowledge. Mr. Brearley also speaks of the need of training by properly-qualified teachers in industrial centres. He fully believes—having with some persistence mentioned it on several occasions during his term of office—that there is a considerable improvement; but he is obliged to say finally that, in his experience, a large number of candidates, who are inadequately prepared to give even a moderate account of themselves, have taken part in these examinations. Now, Sir, what is wrong, and what is the remedy for these conditions? The parties concerned are the Department of Technology, the instructors in the technical schools, the Council of this Institution, and the Examiners appointed by them with the approval of the Department. What has been done by each of these parties to this important work? Mr. Brearley has already alluded to the fact that the Council constitutes an Advisory Committee to the Department. This was brought about some years ago, and he has also kindly alluded to the fact that I had something to do with bringing the two bodies together. The Council did not then see their way to recommend another grade, but they did unanimously agree to the division of the whole subject of "Gas Manufacture" into two—"Gas Engineering" and "Gas Supply." They drew up new syllabuses, Ordinary and Honours, in both; and they have since appointed four Examiners. Mr. Brearley was the first for the new "Supply" division, and Mr. Doig Gibb, who succeeded me, was the first for "Gas Engineering;" but his term of office was unfortunately shortened, much to the regret of all who knew him best, by his translation to another sphere which crowded out examinations. Mr. Thomas Glover succeeded him, and is still in office; and now, Mr. Brearley having retired, the Council have appointed Mr. Walter Hole. I venture to suggest—and this, perhaps, is somewhat in reply to Mr. Helps—that whether the syllabuses are good or bad in his estimation, whether they err in the direction of being difficult, or whether, in the opinion of others, they err in the direction of being too easy, they are nevertheless drawn up by the Advisory Committee to the Department of Technology in this matter, and they represent what the members of the Council consider to be the proper standard of examination for these particular classes and divisions. I venture to think that these syllabuses are not too difficult, and that, worked as carefully as they are by the two Examiners who have reported to you to-day, they are not likely to ask anything more of the candidates than the industry will think absolutely necessary at the present day. I should be sorry to see any considerable alteration in the syllabuses; but I do think, if they go into the melting-pot again, whatever comes out will still be of a wider application and of a more comprehensive nature, because very much fresh knowledge has become current among us during even the period of five years since they were drawn up. As regards the Examiners, we all have the greatest confidence. Where are better men to be found among our numbers than those who have been selected by the Council? We have every confidence in them, and we are greatly pleased to hear the reports on their labours. I am especially interested in Mr. Glover's paper, because he not only lays his hand upon the difficuties, but he is also bold enough, being still in office, to suggest what, in his judgment, is the remedy. We will come to that presently. I am lost, I may say, in admiration of Mr. Brearley's most remarkable and most comprehensive paper. Four years ago, in taking over the responsibility of this new department, he evidently sat down and, previous to beginning his labours, looked at the matter from all points of view. He endeavoured to see the work which lay before him not only clearly, but to see it as a whole. He puts before you to-day, in a masterly analysis, the results of his labours. I think you will agree that it shows the great personal success that may be achieved by an Examiner who diligently sets himself down to take in hand the work submitted to him by the Council, and is determined to go through with it from first to last, and do with it the best he possibly can. He is hampered, he states, with the fundamental difficulty to which Mr. Glover so clearly drew attention—that the individuals presenting themselves for examination have not been properly grounded. There is an absence of preliminary science knowledge which is absolutely necessary before anybody can

hope to get really to work with regard to these candidates, to teach them what is necessary. This must be felt by the technical instructors in the various centres. We must not blame them for the almost hopeless state of things with which these two gentlemen, myself, and Dr. Colman before me, have been confronted. As to the difference between men at the bottom and those at the top, we all know of it only too well. We meet with men who answer every question fully and shortly, and who sometimes get full marks. I am afraid to be humorous on these occasions, because it is not strictly business; but on one occasion, in my experience, a candidate was clever enough to get 101 per cent. of the marks. This was a case of flooring the Examiner. However, the Examiner was clever enough to put him down; but he had to leave him at the top of the poll. I can assure you that at the top of the grade the Examiner's duties are very onerous. I remember on one occasion I had eight papers at the top, and I had to determine the right position of the eight men. That is a very great responsibility, though the examination is not a competitive one except for prizes. I assure you it is no sinecure. We have our duty to do to the industry, and we also have our duty to the candidates. I believe I am telling you the truth when I say that these eight papers were each of them read at least eight times before I could satisfactorily determine their order of precedence. Talk about Sunday work, Mr. President, in the month of May, when "merry lads are playing," the poor Examiner boards, washes, and lodges with the examination papers; in other words, he thinks of them in bed, he thinks of them while he is in his bath, and he thinks of them at the breakfast-table There is a second difficulty which lies in the *personnel* of the examinees. I suppose many years ago, when these examinations were instituted, it was done for the benefit solely of the future gas engineers and managers. There is no question of that. I believe that when the new "Supply" examination syllabus was drawn up, only so recently as five years ago, it was done more with the idea of the future heads and the staffs of the outdoor department. Mr. Glover is aware that foremen go in for these examinations; but he may not also be aware of the large number of the outdoor department who submit themselves for examination. Mr. Brearley's hands are crippled by the fact that the greater bulk of the candidates in his examinations are gas-fitters. That is a very remarkable thing; and I have been greatly interested in the cause of it. Whether it comes from pressure brought to bear upon the fitters, or whether the fitters are really wanting to know, I am not able to say; but if the latter, it is a matter of great credit to them, and one which is very encouraging to all concerned, because the question of the *personnel* of the officers and men of the gas industry is one of great importance, and it has been felt by the large companies recently with regard to the workmen who are brought into contact with the public in their houses —namely, the gas-fitters. Mr. Brearley has arrived at this conclusion by what I can only call a remarkable piece of inductive reasoning; and I think those who have taken the trouble to compare Mr. Brearley's paper with his tables will agree that he makes out a very sound case. That is the second difficulty—namely, the varying nature of the *personnel* of the examinees. The third difficulty is the "young man in a hurry." I am exceedingly glad Mr. Brearley brought forward that letter from instructors—postal instructors, I understand, but that does not matter—because they actually "let the cat out of the bag," and say that the junior examination Ordinary Grade is too difficult to pass in one session. Good gracious me! What is the necessity for passing it in one session? Where has that idea come from? No wonder that Mr. Glover asks for some science foundation upon which the Examiner is to build. But here we are confronted with this sort of thing. I say again that I do not believe for one moment that this is the fault of the instructors. They must deal with the material which comes to them under the regulations with which they are provided. They are in no position to say: "You should not go up for this examination until you have had another session." No doubt they are well aware of the condition of things. I do not know many of the teachers—when I was an Examiner, it would not have been proper that I should; but I do know some of them. Some are our own colleagues—there are several in this room; but they have no control over that matter. Five years ago, the Council of this Institution accepted the responsibility of it; they took the initiative upon their shoulders. I think that, if there is a sufficiently strong expression of opinion upon this occasion, the Council —of whom I would speak with the utmost respect, as I know they have a great deal to think about, and are hesitating at this very moment as to whether the time has not come when some further step should be taken by themselves—will do something in this matter. It is no good waiting for the Technological Department to take steps. They have delegated the initiative to ourselves. I do sincerely hope that when this matter of providing for the technical education of gas-fitters is being considered, the Council will see their way to deal with this wide question of the science foundation required for the teaching of technology. The foundation of an edifice must be broader than the edifice itself. You must have the science foundation upon which to raise the edifice of technology. This is the only point on which I venture to differ from my friend Mr. Brearley. I suggest to him that science teaching *ad hoc*—that is, science teaching directed to a particular department of science—is not what is meant. Science teaching *ad hoc* is technology; the Department of Technology tells you that you want something upon which to build.

Mr. W. CRANFIELD (Halifax): Before I proceed with my quite practical remarks, perhaps I should explain here my standing in this matter. For the last thirteen or fourteen years, I have been continuously engaged in the instruction of the young men of the industry, and for a number of years also I have been an external examiner of evening schools for students, in which capacity I have marked several thousands of papers; so that I can look upon this particular subject really from both sides. I feel an exceedingly happy and proud man to-day in having heard what I have heard. I have long been under a keen sense of indebtedness to the whole gas industry—to the gentlemen who have organized and carried out these examinations; and this indebtedness is considerably enhanced by what I have heard from the readers of the papers and the speakers who have addressed the meeting so far. I am gratified to see what a large amount of interest this apparently remote subject of examinations has for the Institution, as evidenced by the numbers who are here. These courses and their examinations are very much more than a mere testing, weighing, and labelling of men. Your Examiners have told you this morning that it is very largely pioneer and missionary work. The best work that has been done has not been the mere examination and labelling, but the general stimulus that it has given to the whole question of technological instruction. From a very wide experience of students in a good many parts of the country, I can assure Mr. Browne, in reply to his question, that the greater part of the candidates, so far as my knowledge goes, sit quite voluntarily. In some cases there are a number of engineers who signify to their employees their desire that they should take part in these courses, and perhaps sit for examination; but I should hesitate to use the word "pressure" in any single case that has come under my notice. The gratifying and great increase in the number of students who have sat at these examinations during the last fourteen or fifteen years is a general indication of the sense of the need of personal education and greater fitness. That is one purpose which the examination has in view, though, of course, while this missionary and stimulating influence must not be overlooked, it is also a weighing, and a measuring, and a labelling; and therefore, with some amount of confidence, I would suggest that there have been occasions when this point of view has been rather uppermost in the examination. While this pioneer work is necessary in the way of questions to open out the promised land, it is not to be forgotten that the examination has a certain amount of value as an indication of the state of a man's knowledge; and, therefore, it is very necessary that the paper should not be at all one-sided, and that it should pretty well cover the ground, as in most cases it does. I am particularly happy in feeling that I am no longer a "voice crying in the wilderness." For years past I have been, in every possible way that I can, emphasizing the facts we have heard this morning, both from Mr. Glover and Mr. Brearley, and that is the need of the opening-out of these examinations, and the providing of easier first steps. As we have been told, a considerable number of retort-house foremen and accumulator men enter for these examinations. I remember, with very great interest, that a student who, a few years ago, was at the top of the tree in the Ordinary Grade of "Gas Manufacture" was only a Yorkshire meter inspector—uniformed and paid as a meter inspector. There

are a considerable number of these very estimable men, in what I call the lower ranks, who are too old to lay, broad and wide, the foundation of their scientific equipment, but who still want to enter for this examination. To sum it up, though I do not want anything like a cheapening of the examination or of the whole course, I do want very carefully to safeguard the ultimate interests of these men—not to discourage them and put them out of court by a too difficult first step. I have been accustomed to put the situation in this way (I am particularly referring to gas engineering), that I regard it as axiomatic that the syllabus and the examination in the first stage should not go beyond the equipment and the practice of an average medium-sized works, and the equipment and practice that the assistants will have a chance of handling. Therefore, the minutiæ of gas analysis, the calculation of chemical equations, referring to sulphur contents, and so on, might judiciously be postponed for a bit. I am looking forward, in the light of what Mr. Glover and Mr. Brearley have said, to finding an enlarging of this syllabus, making it perhaps three grades. There are several ways of doing it. It might be by making the top grade as difficult as you like—making the attainment and the possession of the final certificate something to be striven for, something to be proud of; in a word, make it difficult, and, if you like, add a practical examination to it. But, for the sake of encouraging the industry as a whole, do not let the first step be too hard. We have to remember that many of the men who sit for these examinations, and many of those who are attending classes and not sitting for examinations, are men who are making very big sacrifices to do something. They are making sacrifices of money, which I have been surprised at, and sacrifices of time to which many of us perhaps could hardly rise. They come to evening classes, and such like, after a long and fatiguing day's work, and very often after a comparatively long journey, to be faced with what I am afraid is being overdone, in some parts of the country—the demand that the student should come three or four days a week, so as to work through a systematic course. I have had to fight against this; and I am afraid "the stars in their courses" have been fighting against me. But the idea of this three and four nights' course has got a strong hold on many, particularly in the North; and the burden is almost a great deal more than the young men in the industry can bear. I have very little further to add. The reaction against examinations is returning; but I think we are realizing that there is a value in examinations, and there are types of examination which I think we might introduce. It is possible to set gas-fitters an examination consisting of a considerable number of short, easy questions which would facilitate their answering, and setting them not so much drawings to prepare but give them drawings, and ask them to work from them.

Mr. J. Paterson (Cheltenham): I want to take, at once, a very emphatic line in this discussion. I think it is one that will not be without interest to everybody here; and I am sure it will have a considerable amount of support. The readers of the two excellent papers we have heard this morning appear to have realized the essential difference there is between education and examination. I do feel that we are at the turning-point, and that unless we realize that the examination is not the end, but simply the means to the end, we shall be in great danger of going astray. I feel very strongly on this point, because I was one of those who were fortunate enough to be associated with the Manchester District Institution in framing this scheme for the education of gas-fitters. I am betraying no secrets when I say that the scheme, as originally proposed, was very largely, and almost fundamentally, modified as our discussions proceeded. The scheme, in the first place, provided for the examination of gas-fitters. There were a few of us at that meeting who were strongly opposed to this, for reasons which I will give you shortly. The view that was presented by certain members of the Committee was discussed and deliberated upon; and I am glad to say that the Manchester Institution modified their original scheme, which a very careful hard-working Committee had brought up. Now the scheme, as it stands, is absolutely dissociated from any such idea as the examination of gas-fitters. It is for the education of gas-fitters, because it is felt that the idea of examining a man in the trade he is going to pursue for the rest of his natural life, and making his passing the examination the key to the success or failure of his whole life's work, is too much to ask any man to go through. That is one very strong reason. Another one is the point Mr. Brearley brings up several times in his paper, which shows that he himself, as I knew from my personal conversation with him would be the case, fully comprehends the difficulty I am alluding to. I say that a man, fully qualified in all the branches embraced in the syllabus, is more than an average gas-fitter; that is to say in the examination on "Gas Supply," for instance. Now we hear that a number of gas-fitters have been supposed to have taken part in this examination; and I think Mr. Brearley is right in so concluding. All credit to them, I say. But do not let an examination on these and other lines amount to a *sine quâ non* for the gas-fitter's qualification for his work. I do say that the more a man studies and learns about his work, the better it will be for him, and the better it will be for his employers. But there is a great danger if that is made the basis of a man's employment. This view was shared by the members of the Trade Societies at the conferences held under the auspices of the Manchester District Institution. I think I am right in saying that they unanimously agreed to this point of view—that it was putting too much in the way of qualification upon the career of a gas-fitter. However, do not let my remarks on the point be taken as in any way reflecting upon the extreme value of the examination carried out by the City and Guilds of London Institute. I only want to emphasize this point, because the value of these examinations is enormous. Mr. Cranfield referred just now to the work that is done in preparation; and he is perhaps better qualified than anyone who has considered the subject to speak on it. He agrees that the course of preparation, and the thought that are given in preparing students for the work, are of vast importance. That, I maintain, is the point for which these examinations exist. It is not to certify a man as being a qualified gas engineer, or as a qualified district superintendent. It is simply to certify that he has, by passing the examination, studied the subject, and brought his mind to bear upon it, and that he has gone into the theoretical part of his work rather than confine himself to the practical part of it in his daily duties. Those of us who are now in the position of gas engineers, in charge of gas undertakings, do expect that the rank-and-file of the men who are to succeed us as engineers shall be of the mental calibre and fibre which will enable them to successfully grapple with an examination of the nature of that set by the City and Guilds of London Institute. It is undoubtedly to the benefit of the industry at large that these examinations should continue. There are many points raised in connection with the schemes for examinations now under our consideration, and I should like to draw attention to a few remarks of Mr. Brearley, where he says: "Under examination conditions, many candidates fail to do themselves justice; and their true technical worth in practice cannot always be assessed by this means. That does not minimize the importance, however, of getting them to undergo systematic technical study." There, in a few words, Mr. Brearley has put forward what I have been trying to say in an imperfect manner. I think it contains the gist of the importance of the whole of this most valuable paper. I have with me, but I will not burden you with them, extracts from various utterances by public speakers, highly concerned with the administration of educational matters, on this subject during the last twelve months. There is one only to which I will refer, and it is from a circular by Sir Robert Morant for the session 1911-12 in connection with the Technical Institution, which is one of the greatest importance, and one which we must all recognize as having an important bearing on this subject. The circular states that the examination of full-time day technical students and the first-stage evening, or part time, students is to be handed over to the teachers concerned, subject to regulations extended to them and approved by the Board. There is no external examination. Now, that is the style of education which I think is more suited for the gas-fitter than the examination under the City and Guilds of London Institute. If a gas-fitter is competent to go any further, and take part in the examination, it is so much to his credit. But the whole point underlying my remarks is this: Do not set up an examination for gas-fitters, because, in the long run, I do not think it is going to be of any use to them.

Mr. H. W. Woodall (Bournemouth): I should like to associate myself with the charming eulogy that Mr. Browne has paid to the authors of these papers. I am sure the amount of work which an Examiner has to do, and does

willingly, is quite equal to that of any other member of the industry, and in a great many cases far exceeds it. I trust that the one or two remarks I propose to make will not be taken for one moment as criticizing their work, but only as an honest expression of opinion. I do not think anyone could value the desire to increase the facilities for meeting the educational demands of the employees in the gas industry more than I do; and I have done all I could to give to my Company's employees an opportunity of acquiring information. But when we heard suggestions made as to the extent to which examinations can be carried—I say it with the greatest deference—in taking these examinations as far as our foremen, I venture to think we are approaching a rather dangerous position for the condition at which we have arrived at the present moment. I think all of us who are associated with labour at the present day will agree with me that the first thing you have to look for in a foreman is a man; and nothing in the world can replace self-reliance and initiative. I think that if we try at the present time to place examinations for foremen, and try to get our foremen to qualify for positions by examination, we shall be doing our industry a great injury. I think, with Mr. Browne, that, at the present stage, what we have to attempt to do is to build on a broad foundation. The only people, in my opinion, who can really start from the basis on which we have to build are the young men of our industry who are just commencing their labours.

Mr. Herbert Lees (Hexham): I want, Sir, to emphasize a point that has not been very definitely dealt with, and that is the connection between these papers and the report adopted yesterday. In the report, submitted to the Manchester District Institution of Gas Engineers, it was definitely stated that this scheme should include teaching in practice as well as in theory. It has already been emphasized that it did not follow that examinations should be held. I think this was important for more than one reason. In the first place, what we do need is that the gas-fitters of the present day shall be educated in the method of dealing with their apparatus. Many of them came to the works a very long time ago, and what learning they had they have picked up as best they could. It is intended that this course should be instituted to deal with present-day gas engineers as well as the rising generation. To this end, I feel that we may be faced with small difficulties when the work commences; and one is the provision of teachers. That is, in a measure, met by the work that has already been done in connection with "Gas Supply;" and so far as students are successful, they will be recognized by the City and Guilds of London Institute. I do not think we want to be too anxious to associate this scheme with the Institution. It will be better that it should be regarded as preliminary; and the men who are most efficient in this particular grade will go on to other examinations. It will be something of a feeder to the "Gas Supply" class; and I feel that it would be a mistake if it were regarded as supplementary. If we can bring this about, I feel sure that the "Gas Supply" examinations will, in the future, be more popularized, and that we shall have more successful candidates. In this connection, I should like to say that, in reading his paper, Mr. Brearley made an error as regards the percentage of passes. He gave the percentage in the second class, whereas in the total class there was something like 66 per cent. in the Ordinary and 65 per cent. in the Honours Grade. I will come back to the point of teachers; and I feel that it is incumbent on all those who have the spare time—and it is interesting work—to lay themselves out to undertake this work. It will require a practical gas-fitter. A practical gas-fitter is not necessarily a theoretical man; and it would, in many cases, be necessary, therefore, that there should not only be the practice taught but the theory as well. When the Committee start work, if my experience goes for anything, they will not find it easy to get a sufficient number of teachers of the class required to carry on this work as extensively as it ought to be carried on. I hope, however, that the members of the Institution who are in a position to carry out the work will be interested enough to do it, and that the work will not suffer for want of helpers. I should take exception to one speaker's view of the status and the quality of the fitter. I do not think it is necessary or desirable that the present standard should be altered. It is very gratifying to hear that an inspector can pass an examination; but one would not think of placing that man in charge of gas-works, or in an important position in them. So that it must not be supposed that merely to obtain a certificate is necessarily a passport and a qualification for such an office. I feel sure that if the standard were lowered we should suffer rather than gain in that direction. It is very desirable that men should progress, and lift themselves from the positions they now occupy to higher ones. They must, at any rate, in addition to being able to write an examination paper satisfactorily, have practical experience; and many men can pass examinations without having that experience.

Mr. Walter Grafton (Glasgow): As one who has had in the past to do with a number of the gentlemen whom I see in this room, I should like to add something by way of suggestion to the Examiners. If I may take a concrete case, I see in one of the questions put last year a candidate was asked to describe an ordinary tee or split tee. In Scotland these terms were not usually understood; they use "saddle-pieces." Therefore I should like the Board of Education, or the Committee on Education, to have a seat on it filled by a Scotsman and one filled by an Irishman. If that were the case, then you will be able to give not only one term for the same thing, but the different terms; and a candidate will have a far better chance of passing and doing credit to himself. Besides, we are going away from the ordinary work of the retort to a policy of business habits, trade law, advertising, pushing business, and so forth. All this will before long enter into the scope of examination. I would suggest, therefore, that, rather than send to South Kensington or to the City and Guilds authorities, the Institution should have examinations of their own; and I think it would give an impetus to all examinations. What is the good of setting an examination question such as: "What is wind?" We cannot burn our gas without air. That is wind. But in what form is it wind? The true answer to "What is wind?" is "Air in motion." Anyone can see that he can answer that at once. Therefore I should be extremely glad if, in the future, the Examiners should say what they want from the students. I suggest that the several countries should have a member with a permanent seat on the Education Board or Committee, one representing Scotland and one Ireland; and thus they will be able to use the terms common in those countries.

Mr. W. H. Y. Webber (London): I take your invitation, Sir, to speak on this subject less as a compliment to myself personally, than as an acknowledgment of the work which has been done for the last seven years in this respect by the great Company that I have the honour to serve as instructor—the Gaslight and Coke Company. We have the largest system of the kind in existence; it is my own fault if it is not the best. We have students of two different classes. In fact, we find it necessary to grade them in three classes. But we have what you may call real students —men, that is to say, who have already set their feet upon the lower rungs of the ladder. We have several hundreds of them, and over and above them we have upwards of 1000 working men who have scarcely realized that there is a ladder at all. All these men have passed through my hands now for the last seven years; and they have taught me, I think, a great deal more than I have been able to teach them. We have learned together, I hope. I am also the examiner. I have heard examiners described in books on natural history as "loathsome creatures," who ought to be exterminated at sight. But I do not think that my students regard me in that light, because we know one another, and my students, although our examinations are held on the strictest possible lines, outside the examination-room are encouraged to come to me with all their difficulties and troubles. If I can help them and put them in the right way, I do so. This seems to me the key to the question that instruction must precede examination if you must have examination. Of course, in our case the examination is an informative one. It is not a competitive examination, though we are obliged to mark the answers of the candidates. It is purely an informative one, for the chiefs of our departments and the Directors, and it is also a means of encouragement for the workers themselves. It gives them to understand that the way to promotion leads through accomplishment, and that you know in a big company is something rather difficult. It helps the chiefs in making their appointments, though, of course, they do not make their appointments entirely on the result of the examinations. I do not consider that an outside examination is worth much, because it is quite impossible for any examiner to know whether the man who gets (say) 101 per cent. of marks—a result upon

which I compliment our friend—is a typist or a messenger, or whether he is a man who by and by will be sitting alongside you, Gentlemen, here. I do not intend for a moment in anything that I may say to reflect in the slightest degree upon the work done by the examiners here. On the contrary, I think if I were a member of the Institution I should be disposed, before I sat down, to move a very hearty vote of thanks, especially to Mr. Brearley for the devoted self-sacrificing labour he has given to this work. As to Mr. Glover, of course, he has trodden in a well-known path. As for the syllabus, I regard that as a reminder to the gentlemen present of what they ought to look up themselves. It is about as useful as the catalogue of the Royal Academy. It shows you what should be there, but the quality of what is there is altogether another matter. I quite agree that the great difficulty is for everybody to properly grasp the principles that underlie the work of gas supply. I am sorry the examination has been divided in this way. I think that the subject of gas engineering might be retained, and a higher grade of students admitted to it—those who have previous academical qualifications. Gas manufacture and possibly gas supply should certainly be retained, and this other supplementary work should, as Mr. Lees truly says, be preparatory to it.

Mr. Walter Hole (Leeds): May I, in the first instance, reply to the very mild criticism which has been offered this morning by Mr. Grafton. Mr. Grafton complains about the terms that are used in a particular examination question. The best reply that I think I can make to him is that at least 90 per cent. of those sitting in that division attempted this particular question, and they gave a very fair sketch of the particular piece of apparatus—showing that they fully understood what was meant by the question. In regard to Mr. Webber, I do not at all agree with him in saying that any examiner must be perfectly ignorant of the men whose papers he is reading through. I think it comes out very clearly whether a man has been trained in the workshop, or whether he is a typist or a clerk, and it is merely a question of the framing of the questions, which is a very difficult matter. I should also like to associate myself very fully with what has been expressed by two or three speakers this morning, as to the splendid pioneer work which has been done by Mr. Brearley in the question of gas supply. Mr. Brearley has laid the Institution under many debts of gratitude in the past, and I think not the least is that associated with his long occupancy of the examination chair on "Gas Supply." The mere fatigue of reading through some 400 or more papers is not at all a pleasant experience; and if it were not for stray gleams of humour which one comes across to relieve the tedium, I do not know how anyone could do it. It does relieve the tedium a little bit to be told that the best way of stopping a down-draught is to put a cowl at the top of the chimney. I think you and I would agree that such a method of procedure would eventually, in the words of the student, stop the down-draught. Or to be told that one of the characteristics of a cast-iron pipe is that it shall not kink on bending; or, again, a reply to a question, which does seem rather strange to some of us, that anyone should consider that the giving of chloride of calcium would assist in gassing cases, or that it would be helpful to take one ear of a person and twist it without too much force in opposite directions. I am very pleased to tell you that there has apparently been a very considerable improvement in the papers written this year. Of course, the personality of the examiner comes in here very strongly, and I am not at all sure that Mr. Brearley's standard will be exactly the same; but I did set out with a fairly high standard, and kept it right through. You will be pleased to hear, I think, that, notwithstanding this high standard, in the honours grade no less than 73 per cent. have succeeded in passing the examination, and in the ordinary grade 78 per cent. I thought these figures might be interesting. I should like also to refer to the great difference in the quality of the papers in the two grades. In the ordinary grade I was impressed with the value, as a whole, of the papers. Out of nearly 300 who sat, there were only 60 failures. The general quality of the papers in the ordinary grade was very high indeed, and it was quite a pleasure to read through them. I may tell you that it took me, as Mr. Browne reminded me when he was speaking, no less than two hours to decide who were the first three in the ordinary grade—that is, after having marked my papers. I may put it in another way, and say that no less than six or seven had, I found when I came to gather up the whole of the marks, succeeded in getting 280 or more marks out of a possible 300. You will easily understand that with six or seven candidates who had gone so near as between 280 marks or 290 marks, it was very necessary to check carefully the papers, so as to appraise them qualitatively, and decide which really ought to be brought to the top. Mr. Brearley says that the greatest difficulty confronting an Examiner is to make such a selection of questions each year as will enable him to arrive at a fair conclusion as to the candidate's knowledge of the whole subject. This brings up the question of the shortcomings of examinations. What is the aim of these examinations, and how are we to attain that aim? I think that the aim we ought to have before us is to ensure, so far as examinations can influence the result, that those who come after us to occupy high positions in the industry shall be men who have been thoroughly trained—men who know what they are dealing with from the theoretical and practical points of view. I think that the man who is going to be the most valuable will be the man who can take the tools out of his workman's hands and do the work better himself on the one hand, and yet on the other is a thoroughly theoretical man. The theoretical man with the practical training is going to be the valuable man for our industry. One other point I should like to make is this: The missionary character of these examinations has been referred to. It has been very amusing to me, in reading through the examination papers this year, to find how frequently, when it was at all possible, some reference to an answer to a question set in previous years has been drawn up. For instance, in last year's "Gas Supply" paper, a particular question created a great deal of puzzling, I think, in the minds of some students. I know it did in my own when I saw it; for I did not quite see what was being driven at. Now I should think half-a-dozen students this year have answered that particular question. I have not had an opportunity of asking Mr. Brearley what his solution was, and I should be rather interested to know if those students have really hit upon it. As to the future, I quite agree with Mr. Brearley in thinking that preliminary examinations in "Gas Supply" would be advantageous. I think the three examinations should be "Gas-Fitting," the wider aspect of "Gas Supply," and then the Honours stage of the latter. I do not agree with him in his idea of splitting-up the Honours paper into a gas-fitting paper and a wider Honours paper. I think it is perfectly obvious that the preliminary paper should be split up; but I think that those who take the Honours stage should have a grasp of the whole subject.

The President: I think, gentlemen, I must now close the discussion. There is one little point with respect to the gas-fitters' education scheme which has not come into it—and it is one we must always bear in mind—that it is not a scheme that affects the gas industry alone, but that it does affect the trade, and that we must endeavour to carry them with it in whatever we do.

Mr. Thomas Glover: There is very little to reply to, so far as I am concerned, except to emphasize, not the value of the examination itself, but what the examination means to the student in his training; and though I suggested that it might be advisable, at some future time, to have an examination for foremen, it was only that we might make the examination more suitable for that class of men. I take it that the slight criticisms made with reference to examination and its effect on men, though we would not promote a man to be foreman because he had passed his examination, all other things being equal, we should prefer a man who had studied, and who had made himself efficient by book knowledge and by practical experience, rather than a blockhead who only knew how to do things by rule-of-thumb. Rule-of-thumb is very good indeed, and cannot be valued too highly; but I think a man who has put himself under training, other things being equal, ought to be a better man. This applies in all directions. I have to thank Mr. Browne and the other speakers who know the difficulties of an examination, for their appreciation of my paper. Perhaps those other matters which were suggested with regard to previous training, and so forth, will come under the notice of the Council at a later date.

Mr. Brearley: I think, Sir, it is not necessary for me to reply individually to each contributor on this subject. I have to thank sincerely those gentlemen who have complimented me upon my work as an Examiner. I am afraid I hardly deserve all the encomiums passed on me; but I especially value the appreciation of Mr. Browne. I always admired his earnestness and the great work that he did in

connection with examinations. I do not mind betraying a secret, and saying that if it had not been for the pressure he brought to bear on me in a long interview we had on the subject, I do not think I should have entertained the examination duties at all. There are conflicting ideas as to the subject of examination and education. Mr. Browne and one other gentleman argued for a broader foundation. Mr. Cranfield seems to argue for a narrower foundation—not to burden the students or the candidates with too many requirements. These and many other topics I think we may safely leave for the consideration of the Council, to make any modification of the syllabus that may be decided upon. They are not personal matters; they concern every member of the Institution as much as they concern me. I must say that Mr. Lees' remarks almost staggered me. I was surprised at the confession by him that examination was not being entertained, because the very last paper I had yesterday alluded to the City and Guilds of London Institute. Why was the Institute alluded to if they were not contemplating examinations? I think this discussion would have been simplified if, as Mr. Paterson said, we did not set up an examination for gas-fitters in the first instance. Mr. Lees says examinations are not thought of. If that is so, the matter is much simplified, and there is no urgency at all about altering the syllabus. I did not want any gas-fitters' syllabus to be submitted without due consideration to the existing syllabus in "Gas Supply." This point having been made, I think there is no haste about altering the examinations. Again I would thank all the contributors to the discussion, to whom I have not replied in detail owing to the lateness of the hour.

[Communications.]

Mr. J. G. Tooms (Waterford) writes: Being unable to catch the President's eye at the meeting on Thursday, I take this opportunity of making the following comments on this important subject. I consider that this is a matter which should not be left to the Council, the City and Guilds, or the students themselves. It is a matter in which every member of the Institution has a duty, and ought to bestir himself. I am convinced that vast improvement can be effected in the desired direction by employers themselves taking a direct interest in this matter. Experience leads me to believe that only in exceptional cases is it possible to materially improve the acquirements of existing employees; and it is to the rising generation that we must look for the results of better education and more competency. The undertaking with which I am connected has for some years recruited its apprentices from the "Trades" preparatory class of the Local Technical Institute, where boys leaving primary schools are given a two years' course in the fundamental principles underlying general tradesmen's operations, practical and theoretical. When these boys are engaged by us (at a higher rate of wage than that paid to boys not having attended such a class) they are required to attend for two or three years on the afternoons of three days in the week during the school session, for two hours per day, an apprentice class suited to their particular trade; and further to attend evening classes in technical subjects. But they are not, after attending evening class, required to be at work the following morning till after breakfast. I may here quite briefly point out the fact of our engaging apprentices as aforesaid ensures that they have reached a fair standard of education. Judging from some of the boys who were first engaged, they will be anxious, at the end of what I may term the compulsory education period, to continue their studies, and what is most important, they will have the foundation upon which to continue them. It is my belief that the good effect of such a system as we adopt will be more effective than any outlined at our meeting to-day for moderate or small undertakings. As a member of the Committee of Management of our Local Technical Institute, I am fully aware of the anxiety of the governing body to cater for the needs in general of the industrial community and any trade in particular; and I should imagine that on your side of the Channel much improvement might be effected in the educational acquirements of gas-works employees, by co-operation of gas undertakings with the technical authorities in their respective districts on similar lines to those indicated above.

Mr. H. Kendrick (Stretford): The twin papers of Mr. Thomas Glover and Mr. Brearley are deserving of great attention and sustained debate, as they open out to us a field which has to a great extent been neglected in the past, or at least not treated with the importance it deserved. Truly we have devoted more attention to the requirements of the engineering side of our profession; and special provision has been made in most centres for holding classes in this branch by teachers more or less efficient. It will not be, however, until we can force upon the University authorities a sense of the importance of our industry, and impress upon them that it is essentially a highly technical branch of chemical engineering, that we may hope to obtain recognition and the place among the professional men of the day that we are entitled to. The managing chiefs of the industry are slowly recognizing that the old order is disappearing, and that with the introduction of vertical retorts, heavy charges, modern machinery, and more scientific methods of purifying, engineers and managers must be a much more highly-trained body of men, and are generally more willing to grant the chiefs of the undertakings more expert assistance than they were a few years ago. With advancing knowledge on the part of our rulers, we may hope to have reflected on University and other educational authorities some of the influence which is moving the industry and induce them to recognize gas making as a great scientific industry and grant us educational facilities, as is done for the electrical industry. The University of Leeds has done admirably; Manchester is trying to follow suit; and if the surrounding authorities will only find the funds (as they will assuredly benefit by such a connection), the industry as a whole will undoubtedly progress and be raised to the position in the public esteem it ought to occupy. If similar courses were instituted as at Manchester in connection with Liverpool, Sheffield, Birmingham, and the older Universities, we should have a better class of men entering the profession—better because better prepared to meet the numerous new problems and conditions that are now constantly facing us. This may seem outside the four corners of the two papers presented for discussion; but as I take it that the object of the papers was to discuss all the needs of the industry in this direction, I trust these few remarks will not be ruled out of order, and that the whole discussion will eventuate into something tangible that will benefit the gas industry as a whole. Mr. Glover raises the interesting question of the two-fold character of the gas engineer's training, and emphasizes the ease with which the chemical questions are answered in the examinations. Is not this because this side of our business may be learned from text-books much easier than is the engineering side, and gives rise to the advisability of splitting the "Gas Manufacture" course into engineering, chemical, and distribution—the first to run along established practice of mechanical and constructional engineering, building construction, and civil engineering training; the second, the ordinary course of inorganic and organic chemistry, applied chemistry, light, heat, and electricity, both with special reference to the gas industry; the distribution course to follow the lines of the gas-fitters' education scheme now before the Institution, but tucked up with the "Supply" course so ably inaugurated and conducted by Mr. Brearley? It is quite true that the "Supply" course, in the event of the adoption of the gas-fitters' course, will require to be modified. I am quite sure, however, that is not beyond the ingenuity of the Council; and the Committee representing the District Gas Associations and the allied trades would, I am equally sure, collaborate with any Sub-Committee appointed by the Council. As in the gas-works itself, modern practice demands the splitting up of the responsibility, and men of all grades will require to be specially trained for the various departments now existing in a gas undertaking. Pressure from outside and the increased use of modern methods of manufacture, distribution, and appliances demand a highly-trained technical staff in even the medium-sized works; and the sooner this is recognized and acted upon the better shall we be equipped to meet increasingly severe competition. We must educate our chiefs, assistants, and foremen, as well as our inspectors and our workmen; and I think that the Council would be well advised to take the matter up in no mean spirit, and do their utmost to place educational matters on a sound basis all round at the very earliest opportunity. The suggestions of the Manchester Institution, backed as they are by the majority of the District Associations, modified slightly as suggested by Mr. Brearley, are certainly a step in this direction; and we should do our utmost to see that this first part, at all events, is put in force next autumn. One difficulty I know there is—that is the dearth of competent teachers. But Rome was not made

in a day, and surely the gas industry is not so self-satisfied with the present position of affairs but that the breach will in a short time be filled. There are plenty of self-sacrificing men among the seniors and so-called juniors of the profession who have the necessary knowledge and ability, and we can safely rely on their patriotism to come forward until the ranks of teachers of our special subjects are filled to overflowing.

Mr. R. HALKETT (Leeds): I trust that my few remarks *re* examinations in gas supply suggested by Mr. Brearley's able paper will not be out of place. As I am but a young member of the Institution, I hope it may not be deemed presumptuous on my part to enter into the discussion, particularly as I am unable to attend the meeting. It may be that my suggestions appear to you to have no value in themselves, or that others may have already given voice to them. In that case, I must apologize for taking up the valuable time at the disposal of the members. The point I wish to place before you is the question as to the advisability of a *vivâ voce* examination in conjunction with the written examinations already in vogue. The training of the embryo official of the outside department appears to greatly depend upon his technical knowledge and ability to pass a written examination. No matter in what branch of the profession he serves, if he can study and successfully gain his certificate in gas supply, he is apt to deem this sufficient qualification to hold a responsible position on the outside staff. But it seems that, with a purely technical man, additional qualification is necessary. Some of them, when faced with the actual object, cannot recognize and properly name the apparatus they have so glibly written about at the examination. It is questionable whether they are in a position to supervise and advise workmen on the district, particularly in an emergency. The study of the papers during the last few years, and also of Mr. Brearley's reports, has originated the idea that a way to overcome the difficulty would be to divide the final examination into two parts—namely, written and *vivâ voce*. In this manner a fuller grasp of a student's qualifications could be obtained, together with his knowledge of the general routine of the outside department. It would be necessary to make various centres for examination, so that all would-be students could participate in the examination without a great deal of additional expense and loss of time. While the system for the written examination now held could remain unaltered, the *vivâ voce* would entail extra examiners. I venture to say that many of our engineers would willingly give their services for the short time necessary, feeling that by so doing they were conferring a benefit upon the profession, and the diploma would gain in value.

Unemployment Insurance.

As announced last week, the comprehensive character of the provisional list of workers that has been issued by the Board of Trade (embracing as it does almost all those employed upon gas-works) as coming under the Unemployment part of the National Insurance Act has occasioned both surprise and action on behalf of the gas industry. Our last week's statement conveyed the intelligence that the matter had been taken up by the Committee of the Gas Companies' Protection Association, who held a meeting the previous Thursday to consider it. It was attended, by invitation, by Mr. Charles Carpenter, Mr. D. Milne Watson, Mr. Stanley H. Jones, and Mr. F. J. Bradfield. In the result, the matter was referred to a Sub-Committee, consisting of the Chairman of the Association (Mr. H. E. Jones), Mr. Charles Carpenter, Mr. D. Milne Watson, Mr. E. Allen (Liverpool), and Mr. George Clarry (Cardiff); and it was decided to invite the Institution of Gas Engineers to nominate representatives. A further meeting was held on Tuesday afternoon, when Mr. Alex. Wilson (Glasgow), Mr. Samuel Glover (St. Helens), and Mr. John Bond (Southport), were added to the Sub-Committee. The unfairness of the inclusion of certain branches of gas-workers was discussed; and it was decided to seek for a decision in respect to them from the Umpire under the National Insurance Act. The form of application was left in the hands of Mr. D. Milne Watson, Mr. Alex. Wilson, and Mr. G. Clarry; and on behalf of the Association and Institution the names of the respective Secretaries (Mr. F. E. Cooper and Mr. W. T. Dunn) were to be attached to the application. No time was lost over the matter; for later in the week it was being discussed before the Umpire, and in due course his decision will be announced.

Among the honours conferred by the King in connection with the anniversary of his birthday is a baronetcy for Mr. Harold Lincoln Tangye, of Maxstoke Castle, Warwickshire. The new Baronet is the eldest son of the late Mr. Richard Tangye, and Deputy-Chairman of Tangyes Limited.

JOINT CONFERENCE OF COMMERCIAL SECTIONS OF THE UNITED KINGDOM.

In the afternoon of the opening day of the meeting of the Institution of Gas Engineers (last Tuesday), there was held, at the Royal United Service Institution, Whitehall, S.W., the annual joint conference of Commercial Sections of the United Kingdom. All members of the Institution were invited to be present; and there was a very good attendance—the matters submitted giving rise to a considerable amount of discussion. Mr. R. G. SHADBOLT, the President of the Institution of Gas Engineers, occupied the chair; and he was supported by Mr. S. Meunier, of Stockport, the Convener of the meeting, and Mr. E. H. Hudson, of Normanton, who has undertaken the position of Hon. Secretary during the indisposition of Mr. H. Kendrick, of Stretford.

THE BRITISH COMMERCIAL ASSOCIATION.

The PRESIDENT, at the opening of the proceedings, said that, as those present were aware, this was a conference of the Joint Commercial Sections of the various districts in the country; and they must consider it as quite separate and distinct from the work and the transactions of the British Commercial Association. The Association had not yet developed to its full extent. It had its hands very full; and there were many subjects that arose for discussion from time to time which the Joint Commercial Sections could still with advantage discuss among themselves, without handing them over to the British Commercial Association in its present state of development. As time went by, and the work of the Association settled down, it might be possible to arrange matters in such a way that the Commercial Sections would themselves form an integral part of the British Commercial Association. But they were met that day just as if the British Association were not existing, and on the old lines of the last three years. The *agenda* submitted by Mr. Meunier consisted of three items—the advance in cooker prices, the National Insurance Act, and the publication of tar prices.

THE MINUTES OF THE LAST CONFERENCE.

The HON. SECRETARY then read the minutes of the last general conference.

On the proposition of Mr. CHARLES WOOD (Bradford), seconded by Mr. R. WATSON (Doncaster), they were unanimously adopted.

EDUCATION AND CERTIFICATION OF GAS-FITTERS.

The PRESIDENT remarked that the three items he had previously alluded to were the official items, which were included in the circular sent to the different District Sections; but there was another one which he thought they ought to take first. He referred to the report to be made to the conference on the position of the scheme for gas-fitters' education and certification.

The HON. SECRETARY said it would be his privilege to present the report on the following morning to the Institution, as he had succeeded Mr. Kendrick in the position of Hon. Secretary of the scheme. As those present were aware, the last conference relegated the consideration of the scheme to all the District Gas Associations; and, in accordance with this instruction, a conference was held on July 28 last at Leeds, which was attended by Mr. Shadbolt (as President of the Institution) and representatives of the Ironmongers' Federated Association, the Birmingham Master Gas-Fitters' Association, the Institute of Plumbers and Advisory Committee on Plumbing, the Operative Plumbers' Association, the Society of British Gas Industries, the Southern District Association, the North of England Gas Association, the Eastern Counties Association, and the Manchester District Institution. Mr. George Helps, of Nuneaton, was also invited to attend. It was a very representative gathering. The scheme as presented at Glasgow was reconsidered at the meeting; and it was thought that, although it was necessary to proceed with a scheme to deal with the education of gas-fitters, that which had been presented was too comprehensive. Only the first clause was adopted; and the matter was further relegated to another Committee, to be composed of the Manchester District Institution Sub-Committee and one member of each of the District Associations present that day. This Committee met in Manchester and evolved a scheme, and appointed a number of gentlemen to draw up a syllabus on lines approved during the discussion. Every member of the Committee quite agreed as to the lines on which it was eventually decided to present the syllabus to the Institution. This syllabus was set out in an appendix to the report; and it was suggested that the scheme should go forward to the Institution for adoption, as it was felt that the force behind the Institution for getting the City and Guilds Institute and the technical schools to take up the question of the syllabus for classes would be greater than the force that could be behind the Commercial Sections. He submitted the matter to the conference in this informal manner; and if they approved of it, it would perhaps strengthen the hands of the Committee in presenting it to the Institution. They had tried to make the report simple. The syllabus was one which any gas-fitter could take up, and, he thought, be a better man for it. There was one great factor in connection with the scheme; and that was the question of examination. It had been decided, if the scheme went through,

to impress on the City and Guilds the necessity of giving a certificate to a man who had been apprenticed to the business and followed the classes for instruction; and this certificate as to the man's efficiency as a student would be sufficient to get him a certificate as a certified gas-fitter.

The PRESIDENT said he took it that they were all pretty well acquainted with the scheme; and if anyone had what he considered a vital suggestion to make, it might be of advantage to hear it now, and save to some extent the time of the meeting on the following day.

Mr. J. FERGUSON BELL (Derby) remarked that he had received a letter from the Secretary of the Midland Junior Association—in which he said that the Junior Associations would like to be associated with the scheme. It was pointed out that probably the members of these bodies had more to do actually than engineers with the work of fitters. It seemed to him (Mr. Bell) worth while considering whether they should not ask some of the Junior Associations to join them in the matter.

The PRESIDENT said he had a letter from the Joint Council of the English Junior Gas Associations suggesting that in the carrying out of the scheme for the training and examination of gas-fitters, the local district Junior Gas Associations should be invited to appoint a representative to serve on the local administrative committees. It appeared to him that there might be some little difficulty in the way of this.

The HON. SECRETARY said he had received from the Secretaries of some of the Junior Associations inquiries for full particulars so as to keep them in touch with the scheme. Therefore they were fully alive to what was going on. It seemed to him to be rather premature at this point to consider the constitution of the District Committees.

The scheme to be submitted to the Institution was put to the meeting and approved.

THE ADVANCE IN COOKER PRICES.

A discussion then took place on the question of the two recent advances in prices of gas-cookers.

Mr. MEUNIER said there was a feeling that the first 10 per cent. increase was probably justified; but the question was whether there were good grounds for the second increase. It might be well to get some expressions of opinion, and, if necessary, take steps to approach the makers, either directly or indirectly, and get them to justify their position or make a reduction.

Mr. D. T. LIVESEY (East Grinstead) suggested that if a small Committee representative of the conference were appointed to confer with the makers, this might help.

The PRESIDENT, after further remarks had been made, suggested that a Committee should be formed, composed of one representative of each Commercial Section.

Ultimately this was agreed to, on the motion of Mr. LIVESEY, seconded by Mr. J. CARTER (Lincoln).

THE NATIONAL INSURANCE ACT.

The PRESIDENT said that they knew the state of affairs at the present time so far as the Institution were concerned; and possibly, unless someone had a very good suggestion to make, it might be as well not to occupy themselves too much with this question at the present moment, because the Committee would be meeting later in the afternoon, and in consequence of this meeting the matter might arise before the Institution. The duty this Committee were charged with was to endeavour to state a case to the Umpire.

After some remarks by Mr. R. W. EDWARDS (Aldershot) and Mr. JAMES PATERSON (Cheltenham), it was agreed, pending a further report, to leave the matter to the Institution.

PUBLICATION OF TAR PRICES.

The last matter discussed was the publication of tar prices.

Mr. MEUNIER said that this was a matter which was handed over to the Manchester District Commercial Section to deal with; and letters were sent to the various Secretaries of other Sections, with the object of obtaining their views, The response had, however, been very poor indeed; and, as a matter of fact, he was not quite sure that the question had been thoroughly understood. He then proceeded to explain the idea.

A lengthy discussion followed, at the conclusion of which,

Mr. J. H. BREARLEY (Longwood) said that, to expedite the business, he would propose that the matter be referred back to the District Associations, each to do as it deemed most prudent for its particular district.

Mr. EDWARD ALLEN (Liverpool) seconded this; and it was agreed to.

THE CONVENER.

The PRESIDENT said that, before they separated, it was usual to elect a Convener to call them together possibly twelve months hence, or in the interval if he considered it necessary.

On the proposition of the HON. SECRETARY, seconded by Mr. OCTAVIUS THOMAS (Pentre), Mr. Meunier was re-appointed.

THE SECRETARYSHIP.

The PRESIDENT remarked that they would be pleased to know that Mr. Kendrick thought his health was sufficiently improved to enable him to take on the Secretaryship again, if the members desired it.

This statement was greeted with applause; and Mr. Kendrick's offer was accepted, on the proposition of Mr. ALLEN, seconded by Mr. WOOD.

The PRESIDENT asked the Hon. Secretary to add a note congratulating Mr. Kendrick on his recovery.

THE PRESIDENT THANKED.

Mr. WOOD proposed a vote of thanks to Mr. Shadbolt for presiding over the meeting.

This was seconded by Mr. EDWARDS, and carried with applause; and with the PRESIDENT's acknowledgment, the proceedings closed.

DEPRECIATION AND INCOME-TAX.

A Draft Scheme.

Last Wednesday afternoon, there was held at the Royal United Service Institution, Whitehall, S.W., a meeting of representatives of gas companies in the United Kingdom to receive a report of the negotiations which have taken place between a deputation consisting of delegates from the Institution of Gas Engineers and a Committee representing several large gas companies and the Inland Revenue authorities, in connection with the question of depreciation allowance and income-tax. There was a very full attendance. At the outset of the proceedings, Mr. Corbet Woodall moved, and it was agreed, that Mr. R. G. SHADBOLT, as President of the Institution of Gas Engineers, should take the chair.

The PRESIDENT: By way of opening the proceedings, and making things clear to those who possibly may not have an idea as to how this movement has arisen, I will call upon Mr. Corbet Woodall to introduce the matter.

THE ORIGIN OF THE MOVEMENT.

Mr. CORBET WOODALL: The subject that we have to discuss this afternoon is, I need hardly remind you, one of universal importance to those who are engaged in our industry. Many references have been made to the matter in the Technical Press; but so far very little has been done towards placing the subject in a satisfactory position. It will be borne in mind that the Customs and Inland Revenue Act of 1878 states that the Commissioners shall allow such deduction as they think just and reasonable as representing the diminished value, by reason of wear and tear during the year, of any machinery or plant; and in the Finance Act of 1907, it is provided that the Commissioners, in assessing profits, shall make such allowance in respect of claims for wear and tear as they think just and reasonable. It will also be within the knowledge of most of those present that schemes allowing for certain rates of depreciation for income-tax purposes have already been sanctioned by the Inland Revenue authorities, to municipal corporations, for instance, and to certain trades, including (among many others) printers, brewers, and such like. Other trades had special terms arranged with the Commissioners. Appeals have at various times been made to the Commissioners on behalf of individual gas companies; and in certain cases—mostly small companies—terms have been arranged. I believe, however, at the present time there are a large number of such cases awaiting adjudication. In some instances the Inland Revenue authorities have passed accounts year after year in which depreciation has been shown—depreciation often to a very large extent in excess of the ordinary provision for repairs and maintenance. But you will remember the circular that was issued, I think, in 1909, to the effect that henceforth there were to be no such depreciations; and the surveyors consequently have disallowed them. This created a position that naturally suggested not only concern, but real alarm, because if it was upheld, then not only would the allowance be disallowed in the future, but there would be the serious question to consider of what had been done in the past. Upon this it seemed not only desirable, but essential, that some effort should be made to bring about concerted action, with a view to formulating a scheme of general application. With the object of facilitating such an arrangement, a conference was called of a considerable number of gas companies in the neighbourhood of London; and this conference met at the offices of the Gaslight and Coke Company in January of this year. It resulted in the appointment of a Committee who undertook to take the matter seriously in hand. The Committee as originally constituted held several meetings; and by and by they co-opted on to the Committee certain others who had not been members of the conference—notably among these being representatives of the Institution of Gas Engineers, which brought in our friend Mr. Shadbolt, the President, who gave us material help, and to whose suggestion we owe it that this meeting is being held here to-day. That Committee held several meetings; and in the month of March last I had the opportunity of meeting with one of the representatives of the Inland Revenue authorities on two occasions, and put our case before him. I found in him a man who is thoroughly master of the whole subject, and also a man who, I felt quite sure, was honestly and resolutely determined to find, if possible, an equitable solution of the difficulty. ["Hear, hear."] Following upon these meetings, a deputation was appointed by the Committee to whom I have referred, which waited upon this representative; and they had several consultations during the months of March and April, I think. The result

was the arriving at a scheme which Mr. Cash will explain in detail now, and which we think embodies an arrangement fair to the companies and equitable as regards the Government. For my own part I rejoice very much, particularly in the settlement that has been come to with regard to prepayment fittings. That part of our expenditure had got very much upon my nerves; and I felt quite sure, in the case of a great number of companies, if the practice of carrying this as a charge against capital were persisted in, very serious trouble was ahead. The arrangement come to has at any rate marked out that in the opinion of the Government, as represented by the Inland Revenue, it is not necessary. May I say that I think the holding of our meeting here to-day is a very happy circumstance and a good augury for the future? It seems to me it is a subject which—although it is outside the *agenda* of the Institution's meeting, yet affects the whole industry, as this does—could not be better ventilated than at the meeting of the Parliament of our industry, as the Institution of Gas Engineers is.

The Scheme Explained.

Mr. William Cash: Mr. Corbet Woodall has already outlined to you the general circumstances which have brought about this meeting; and I have been asked—simply because I happen to be a member of the Committee appointed by the conference to which he has referred, and that Committee did me the honour of asking me to act as Chairman—to explain the scheme at which we have arrived. But before doing this, I should like to say a few words as to the past history that has led up to it. In doing so, you must forgive me if I seem to go over the ground at some length; for I think the matter is one of so much importance that it is desirable we should have a clear idea of the question we are discussing to-day. I join with Mr. Corbet Woodall in expressing our great satisfaction that this opportunity has been given us of meeting such a large number of representatives of so many gas companies. It is a most fortunate circumstance; and the suggestion coming from Mr. Shadbolt in the way it did was a very excellent one. Referring to the system of accounts of gas companies, you know, of course, that with gas companies and kindred undertakings of a statutory, and therefore permanent, nature, the accounts are framed by statute, and provide for renewals being charged against revenue; and there is no special provision in the form of accounts for depreciation. But the whole position and general situation have been considerably altered of late years by the fact that gas companies have been gradually led to incur a large expenditure on what may be regarded as a new class of business connected with the hiring of cookers and fires, and the installation of prepayment meters and appliances in the houses of consumers. This meant a large addition to capital, or to a suspense account in the balance-sheets. This plant, of course, is of an ephemeral nature; and everybody was of opinion that sooner or later it should be written-off, and not remain a permanent item in the balance-sheet. Therefore the majority at once proceeded to write-off depreciation, and charge such depreciation against profits. They felt that, for income-tax purposes, they were perfectly entitled to do this, because Parliament gave companies, when this business was first inaugurated, the right to earn a special income in respect of the hire of stoves and fittings and to make an additional charge for prepayment fittings. This was brought into the credit side; and, of course, on it they had to pay income-tax. Therefore it seemed only equitable that they should be allowed a corresponding expenditure on the other side for wear and tear of this plant anterior to its actual renewal, which would follow in subsequent years. We felt no doubt about the position, because the Act of 1878 distinctly provides for an allowance in respect of wear and tear; and in our view there was no doubt such expenditure was in the nature of a renewal of plant and machinery. This was the position up to the time when the circular was issued in 1909, which provided that, so far as gas and water undertakings were concerned, no depreciation should be allowed under any circumstances in respect of any portion of these undertakings. The gas companies at once joined issue on this provision. It is a provision in a circular issued by the Inland Revenue authorities to surveyors throughout the kingdom; and, in fairness, I ought to state how it came into existence. A conference was held which was attended by several bodies (the Institution of Municipal Treasurers and Accountants, the Association of Tramway Engineers, and the Tramways and Light Railways Association); but it was admitted that the gas companies were not represented. The circular dealt with the accounts of tramways, electric lighting, and gas and water; and the result of it was what one might expect—the surveyors at once took exception to all allowances for depreciation. This was followed by various appeals, both to General Commissioners and also to Special Commissioners; and the Special Commissioners decided in a number of cases that the companies were entitled, as we had all along contended, to an allowance for depreciation or wear and tear. While the appeals were pending, the conference to which Mr. Corbet Woodall has referred was called; and the Committee were appointed. Every member of this Committee has been of very material assistance throughout the whole of our proceedings. They were Mr. E. L. Burton (Secretary of the Brighton and other Companies), Mr. G. H. S. Iorns (Ilford), Mr. A. A. Johnston (Brentford), Mr. T. H. Hazell (Newport), Mr. A. Bevis (Gaslight and Coke Company), Mr. Ernest W. Drew (Barnet District Gas and Water Company), and Mr. J. S. Garrard (Eastbourne). Then we had the great advantage of co-opting Mr. D. Milne Watson (Gaslight and Coke Company), and later Mr. Shadbolt and Mr. W. R. Herring, as representing the Institution. Mr. Herring was particularly useful because at Edinburgh there is now a question outstanding regarding the removal of certain works. We also co-opted Mr. B. D. Holroyd (Woking Gas and Water Company). We have further been in touch, through Mr. Johnston, with the Gas Companies' Protection Association. Mr. Johnston has seen the Association; and they have been advised of what we have been doing. As Mr. Corbet Woodall has told you, the next step was, after formulating our ideas, to approach the Inland Revenue authorities, with a view to a scheme being prepared. We were told at once, after our first meeting, that it must be considered that we were approaching the Inland Revenue authorities, not that they were approaching us. This is important. If you here to-day, and the representatives of the gas industry generally, feel that this scheme is an acceptable, fair, and proper one, then we must, when we go back to the authorities, have behind us some substantial assent from a number of gas undertakings, because obviously the Inland Revenue authorities are not going to accept a scheme which will bind only a limited number of companies—leaving them to fight, or test before the Special Commissioners, many other cases throughout the country. May I remind you that this scheme is only a scheme, and does not alter the law of the land. Therefore no company is bound by it, even assuming there were only half-a-dozen left outside. On the other hand, if the scheme is approved by the Inland Revenue, it will be distributed by them to the surveyors throughout the country. The position will be simplified; and I think there is no doubt that a company who felt they could not approve the scheme and desired to appeal against an assessment they thought unfair, would have the scheme brought up against them. The Special Commissioner would say, "Here is a scheme approved by the large majority of companies. What objection have you to your assessment being based upon it?" Still a company would not be bound, but would have to fight their case with such materials as they could command. I should like to emphasize another remark made by Mr. Corbet Woodall. In our opinion the scheme is fair and equitable to all parties. I am sure every one will agree that there is no desire on the part of the companies to in any way "do" the Inland Revenue. We are all anxious to pay what is fair and reasonable, and we are perfectly willing to bear our full share of liability; but we did feel, and felt very strongly, when this circular was issued, that it was not fair to gas companies that no depreciation should be allowed to them, while a scheme allowing depreciation under certain circumstances to electric light undertakings was actually formulated. I may say the Committee unanimously recommend this scheme for your approval; and they had an opportunity earlier this afternoon of submitting the scheme to the conference who appointed them. The conference also have adopted it unanimously. The scheme does not attempt to cover the whole ground, because to make it do so would render it extremely lengthy and probably too elaborate, and in the end might defeat its own object. Now let us come to the scheme itself. The first and most important question was that of plant and machinery, and then subsequently, bound up with it, that of mains. I more particularly allude to such things as scrubbers, washers, purifiers, retort ironwork, pumps, and machinery generally. There is no doubt that such items are plant and machinery; and a company would clearly be entitled, if they so desired, to make a claim for wear and tear in respect of such plant. We had to decide as to whether the scheme should provide for such a claim. The Committee, after a great deal of consideration, and after interviewing the authorities, came to the conclusion that it would be better under this head to claim for renewals only, as distinct from getting an allowance for wear and tear. We thought so because we felt that, in respect of the older companies there would be very little difference between a claim based on the anticipated life of such things and the actual renewal. The majority of companies have been established a number of years; and these renewals fall year by year into charges against revenue as the articles in question wear out. Considerable complication would be brought into anything like a general scheme if all these various articles were to be separately assessed as to life, and an allowance made for wear and tear for each one of them. Another difficulty if this method were adopted is that it would be necessary to keep separate records to distinguish the renewals as they fell due, which would have to be set off against the allowance for depreciation. If an allowance is made for depreciation or for wear and tear, then, of course, you cannot claim as a charge against your profits a charge for renewals in addition. Therefore you must determine whether you will have renewals or an allowance for wear and tear. This being so, we thought it was simpler—and it was strongly urged by the authorities—that, so far as plant and machinery were concerned, we should take renewals instead of depreciation. With regard to mains, there again we felt we were in the same position; and if it had been a question of producing evidence as to the life of mains, the rate of depreciation which we could have sustained by evidence would have been a comparatively low one. Clause I. of the scheme therefore reads as follows:

Plant, Machinery, and Mains.

1. No depreciation shall be allowed in respect of the plant, machinery, and mains, other than as specified hereinafter; but in lieu thereof all expenditure on repairs and renewals is to be charged in the company's accounts for income-tax purposes and allowed as working expenses, as and when incurred. All expendi-

ture on extensions and improvements, where debited against revenue, to be distinguished and excluded from the said allowances.

The last words there are introduced at the desire of the authorities, to cover such a case as is familiar to you all, where a larger main is laid in place of a small one, and the additional value is under this scheme charged against capital. The second paragraph is one introduced to make clear the allowance for renewals, and reads:

2. Provided that whenever any expenditure on such renewals is incurred, and full effect cannot be given to its deduction in the year when incurred, owing to the profits or gains chargeable with income-tax in such year being less than the amount so expended, the balance of the said expenditure, which has not been allowed, may be carried forward and allowed in the following year or years, as is provided in the case of unallowed wear and tear by section 26 (3) of the Finance Act, 1907.

That, of course, is in favour of the companies, and is merely put in there to make it quite clear that if any very heavy expenditure be incurred in any one year, which a company might meet out of its reserve fund, if such expenditure is more than the profits of the year, the balance shall be allowed in subsequent years. Paragraph 3 reads:

GASHOLDERS.

3. In addition to repairs, depreciation shall be allowed at the rate of 3 per cent. per annum on the written-down value. Such value not to include tanks, except where constructed of steel or iron, and in no case is the cost of excavation to be included in the value upon which the depreciation allowance is computed.

Now, we raised the question of gasholders with the authorities for the reason that it is a very large item relatively in the accounts of the smaller companies; and we felt it might be quite open, especially for some of the younger little companies, to, if they thought fit, build up a fund for the renewal of gasholders. It is only reasonable that such items, being exceptional, should be treated separately; and we think the allowance of 3 per cent. granted is a reasonable one. You may possibly ask why the definition is included with regard to tanks. As you know, any allowance under the 1878 Act is in respect of plant and machinery, not buildings. The view of the Inland Revenue authorities is that, if a tank is not of metal, it is a building technically, and therefore must not be included under this particular head. But having regard to the rate of depreciation, we think this is a reasonable and fair arrangement. Paragraph 4 reads:

METERS (ORDINARY AND PREPAYMENT), COOKERS, AND GAS-FIRES.

4. In addition to repairs, allowance for depreciation shall be granted at the rate of 10 per cent. per annum on the written-down value.

This clause covers one of the main points for which we were fighting—namely, prepayment meters, gas-cookers, and fires; and as a matter of negotiation and of settlement, the authorities have agreed to include ordinary meters as well. I am quite aware that a number of gas companies have been writing-off and claiming depreciation in respect of ordinary meters. Others, however, have not; and in a great number of cases depreciation on ordinary meters has not been allowed. We therefore think we have got some concession here, and that the arrangement is fair. I need not say here that it would be difficult to sustain a rate of depreciation of 10 per cent. in respect of ordinary meters, if the matter was gone into closely. The next paragraph reads:

SERVICES AND FITTINGS.

5. No depreciation shall be allowed in respect of services and fittings; but, in lieu thereof, all expenditure shall be allowed as a trading expense as and when incurred.

You know the Act of 1871 contemplates that services should be charged to capital; but we pointed out to the authorities that services are often abandoned. They cannot be recovered if a service of gas to a house ceases; and as a set-off to the paragraph relating to mains, where renewals were to be allowed, and not depreciation, the authorities have agreed that the whole cost of the service in future, as and when incurred, shall be allowed as a charge against profits, and similarly the whole charge for fittings shall be allowed, as and when incurred. You may think it is not quite reasonable that depreciation or writing-off in respect to past expenditure on fittings is not to be brought into account. But, of course, it is bound up in the general settlement we have come to; and if the whole expenditure in future is to be allowed, it is undoubtedly a set-off against any claim we could have made in respect of the item still on the balance-sheet for fittings charged to suspense or capital account in the past. The next paragraphs are definitions:

"Services" are to be understood as representing the pipes which connect the street-mains with the properties served.

"Fittings" are the pipes, pendants, and brackets within such properties, supplied by, and at the cost of, the company.

That is, all those fittings which remain the property of the company. Then follows a paragraph we were asked to insert, and which I think is perfectly fair:

Where fittings so supplied are removed by the company at any time, they shall be brought back into stock, if of any value, and re-issued without any charge against revenue except for the cost of repairs necessary to enable them to be re-issued. In the event of their not being re-issued, revenue shall be credited with the scrap value.

Of course, as the whole charge has been made against revenue, if the fittings are dismantled and sold as scrap the proceeds must be credited to revenue. Nobody could object to this clause. Summing up down to this point, and before dealing with the general provisions which follow, I think I may say we have gained in the ordinary meters, at all events in rate, and again in services, as well as cookers. In mains, actual renewals are met, with no depreciation; and the rate would have been a low one, if it had been allowed. Passing to the next clause, then:

GENERAL.

6. In all cases where depreciation allowances are granted, renewals, if charged against revenue, shall be carefully distinguished and notified to the surveyor, in order that they may be added-back to profits for the purpose of arriving at the income-tax liability.

This, of course, is only fair and reasonable; and I think the paragraph explains itself. Paragraph 7 was introduced to meet special cases, and particularly the case of gas companies who are contemplating removing their works. These are difficult cases to deal with; and the paragraph purposely has been drawn up in somewhat general terms. It reads:

7. If new works are erected, wholly or partially, on a new site, in place of old works abandoned or demolished, a reasonable allowance shall be granted for renewals in respect of the displaced plant, so far as it is actually renewed, such allowance to have regard to the original cost of the displaced plant, less any depreciation that may have been granted; but such allowance shall not include the cost of preparing the new site or erecting foundations for the new plant.

The paragraph distinctly approves of the general principle that a reasonable allowance—these are the words introduced by the authorities—shall be granted to the company; and this meets the case of the objection sometimes put, that where a complete set of works are pulled down that is a capital loss, and as such no allowance can be made in respect thereof against the profits of the particular year or years. We attach some importance to the fact that the words have been introduced—and for this I think we have to thank Mr. Burton—"works abandoned or demolished." I should like to say one word with regard to the concluding portion of the clause—"Such allowance shall not include the cost of preparing the new site." It was pointed out in this connection that in the view of the authorities the cost of preparing the site is part of the cost of the land, and therefore it is not plant or machinery, and so could not be claimed for such purpose as we are here contemplating. Then the words, "or erecting foundations for the new plant." These were rather objected to; but the case was put by the authorities in this way: "Assume a certain piece of plant on existing works is to be demolished, and is to be re-erected. If re-erected on a new site, probably there would be additional expense involved for foundations. If you erect the plant on another site, the additional cost for foundations is one we cannot admit." It deals with special cases which will have to be considered when they arise; but we thought it worth while to insert the clause, which does recognize the principle of an allowance where works are abandoned or demolished. Clause 8 is a definition clause. As the circular, if approved, will go into a great many hands, we have endeavoured to make it as clear and simple as possible; and for this purpose we have added several definitions:

8. All renewals of parts which do not destroy the identity of the original article shall be allowed as repairs, except so far as they constitute an extension, enlargement, or other similar improvement in value.

To take an example, though it would not really apply, because this deals with plant. Supposing a larger main is laid in place of a small one, that undoubtedly is an improvement. Assuming at a certain expense a piece of plant is increased in capacity, to that extent it is an improvement, but only an improvement in value; so that if the cost of doing the work was small, the matter in dispute would likewise be small, and the point was not one of great importance. The principle, I think, is quite clear; and I am sure you will grasp what is intended, both on our part and on that of the authorities. Clause 9 is inserted in order that there may be no doubt whatever as to what is meant:

9. Where renewals are allowable under this scheme in lieu of depreciation, they shall be allowed notwithstanding that the cost thereof may not have been debited in the company's accounts against revenue.

This was inserted principally to make it clear that, merely because a company have treated an item in a certain way in their own accounts, they are not to be debarred for the purposes of the scheme (if they adopt it) from treating it otherwise. Clause 10 says:

10. "Written-down value" means original prime cost, *plus* subsequent additions (including renewals), less all allowances actually granted for income-tax purposes in past years in respect of depreciation.

Let me give you a simple example of how this would work out. Take the case of a gasholder costing £50,000, and assume for five years 5 per cent. on the prime cost has been allowed, and 25 per cent. therefore written off, that will be £12,500. The commencing figure for the scheme would be £37,500. But, of course, only is this sum to be deducted as the sum for depreciation if it has been allowed for income-tax purposes. The clause also will apply to clause 4, meters, cookers, and fires. The words "including renewals" were introduced to make it quite clear that when renewals take place they should be added-back to the original cost in order that depreciation may be allowed on them. The effect

of clause 10 is that the allowance will be calculated on diminishing value, because the words are "prime cost, *plus* subsequent additions, less all allowances." Therefore all allowances throughout this scheme will be calculated on diminishing value. The Committee of the original conference would have liked to have obtained sanction to an allowance based on full prime cost; but —with the exception, I think, of steamships—that is contrary to the practice of the Inland Revenue. They gave as the reason that, under their system, you start with (say) a sum of £100, and allow a certain amount for wear and tear during a stated year. Next year, you start with a smaller sum; and this figure appears as the record in the books of the Department. And so on. They say it would be impossible for the department to keep records for the trading concerns of the kingdom, if they had to keep a record to show the date when the allowance would cease. Therefore the practice is to allow depreciation on diminished value. And if you come to work it out, I do not think the matter is of such importance as would at first sight appear, because obviously a higher rate would be granted; and in a few years' time the amount of depreciation on diminished value would be as large as if calculated on the lower rate at the full cost. Clause 11 reads:

> 11. "Expenditure" means the sum expended on materials, labour, and incidentals.

This was inserted in order that there might be no doubt whatever that where the word "expenditure" is used, as it is more than once earlier in the scheme, labour is to be included, as well as materials. Referring to clause 5, clause 11 makes it abundantly clear that the cost of laying services and installing fittings is also to be brought into account in making the calculations; and "incidentals" are added to include cartage and carriage. Clause 12 reads:

> 12. This scheme shall take effect for the year 1912-13, and for years preceding where claims of depreciation are now awaiting settlement.

Probably you know there are quite a number of cases which have been deferred, to be dealt with before the Commissioners; and this scheme will apply to them. Some go back more than one year. Clause 13 is as follows:

> 13. Where, in any case, allowances for depreciation have been made which are now to be discontinued, and they have not been exhausted by renewals already effected, the amount of such unexhausted allowances shall be deducted from the expenditure on future renewals as and when they are effected.

That paragraph is inserted at the desire of the authorities, and is taken almost word for word from their circular of July, 1909, which was framed primarily for tramways and electric lighting. It means, if I may interpret it, this: Assuming a company have put on one side certain sums for renewals and depreciation, and these sums have been allowed for income-tax purposes, they will be brought into account and be exhausted by renewals before actual renewals will be allowed. There are very few companies, I think, to whom this section would apply, and we saw no objection; and I do not think it is important. That ends the scheme; and I should like to say I am in a position to state that we have every reason to expect the scheme will receive the approval of the Board of Inland Revenue. The document is marked "Private and Confidential;" and it must not be used, except that surveyors may be told that negotiations are pending. We have had a case this morning where a surveyor has agreed, on a statement to this effect, that the assessment may stand over pending a final settlement of this question. We are now all busy with the assessments for 1912-13; and it is desirable that the matter should be settled as soon as possible. I have also pleasure in saying the Committee are unanimous in regarding this as a satisfactory settlement, and strongly recommend it for acceptance; and the conference who appointed us have agreed to it in principle and generally. I personally, so far as my opinion is worth anything, have no hesitation in saying I think it is a fair and reasonable scheme; and for my companies I shall adopt it. But we want to get your approval to the scheme. It would not be fair to ask you to pledge yourselves now to adopt the scheme; but we ask you, on a show of hands, to say whether you approve of the scheme. Then an opportunity will be afforded you of signifying formal approval on behalf of your companies in writing within say a week or ten days. If I or any member of the Committee can do anything in the way of further elucidating the scheme, we shall be pleased to do so.

Some Other Views of the Scheme.

The President said that before proceeding to questions, they would like to hear a few supplementary remarks by Mr. Burton, who had been indefatigable in making suggestions and putting forward various aspects of the question. He had been greatly instrumental in bringing the matter to the point it had now reached.

Mr. E. L. Burton said the matter had been so lucidly explained that it was hardly necessary for him to say anything further. There were, however, a few more arguments that might be taken into account in support of the scheme. First of all, if certain companies declined the scheme, in all probability they would be thrown back on the necessity of appealing; and it seemed to him that this in itself was open to considerable objection. He knew the trouble involved in appeals, and the unsatisfactory results achieved. They had to lay their whole case before the Commissioners; and any return obtained was in the shape of a lump sum allowance, without any intimation of the basis on which the allowance was made. Consequently, if once embarked on the process of appeal, it might be necessary to go on from year to year. This was the individual aspect of the matter; but the question should rather be considered as applying to the whole of the gas industry. It seemed to him they ought to pull together for their mutual help. Some trouble and time had been expended on arriving at the result so far attained; and the success of the movement would depend upon whether a sufficient number of companies came in to support the scheme. He had hoped that they would be allowed to take their depreciation on the prime cost, as this was the proper method; but he quite understood the argument of the authorities, and admitted that it would have meant a great deal of book-keeping. Speaking for just the few gas companies that he specially represented—he supposed the capital would be from £1,250,000 to £1,500,000—he could say they would accept the scheme cordially. That was to say, the Directors would cheerfully acquiesce in the bargain arrived at. He did feel that they had obtained a scheme worthy of acceptance on behalf of the whole of the gas companies of the country.

Mr. C. Comins said he had not before him the circular of 1909; but he would like Mr. Cash to state in what way the scheme now proposed differed from the regulations laid down in the circular to which so much exception was taken. He was not quite sure as to the concessions granted, beyond the 3 per cent. for gasholders; but if the scheme were adopted, he believed it would be a great advantage to every one interested in gas companies, because they would secure uniformity of practice. He would like to take this opportunity of thanking the members of the Committee and the conference for the efforts they had put forth on behalf of the gas industry.

Mr. Humphreys Davies expressed the opinion that there were some cases in which the scheme would work great injustice if carried out. Therefore he would like to know whether the scheme was to be taken as a whole or was subject to modification. Circumstances differed so much that uniformity of practice could hardly be thought of. If the scheme were approved by such a body of men as were present at this meeting representing the industry, it would be perfectly hopeless for an individual company to start an appeal. It would prejudice them very much. He suggested the insertion of a clause to make it clear that if a company did not accept the scheme it should not be prejudiced by the fact that 99 per cent. of the companies had accepted it.

A number of questions on various points of the scheme were asked by different representatives; and to these

Mr. Cash replied. Alluding to Mr. Comins's remarks, he said the opening words of the circular of 1909 were: "Gas companies—No depreciation should be allowed in any circumstances on any portion of these undertakings." The scheme made an allowance in respect of meters, stoves, and fittings; and there were cases where, relying on the circular referred to, surveyors had refused to allow anything for depreciation on these things. Therefore they had got a long way from this. Of course, they as an industry had never agreed that the surveyors were right. One of the main objects was to attain uniformity. Mr. Humphreys Davies thought the scheme might work injustice to certain companies; but he disagreed with him, though, of course, it was conceivable that some might not do so well under the scheme as they were doing to-day. Companies in this position might, however, rely upon it that the position would not remain unchanged. The Committee were trying to legislate for the general body. It was perfectly open to any undertaking to say it would not join the scheme. He did not think, except in a very general sense, a company would be prejudiced by the fact that the large majority of other companies had adopted the scheme. But the Committee did think, rightly or wrongly, that under the scheme companies would probably do better than by each fighting its own battle.

The Resolution.

The President said they would now like to have an expression of opinion from the meeting; and to arrive at this, he would submit the following resolution, which he would ask some gentleman in the body of the hall to second: "That this meeting of representatives of gas companies of the United Kingdom, having considered the draft scheme submitted to them for a proposed basis for deciding depreciation allowances for income-tax purposes, do hereby approve the same, and recommend it for adoption by the gas companies of the United Kingdom." This left each company to take it or not, as they thought fit.

A Representative from Blaina seconded the motion, and said their thanks were due to the Committee, who had done their very best. [Applause.]

Mr. Cash said he ventured to think the resolution was admirably framed. The intention was that no one should be absolutely bound. It was a recommendation for acceptance. It would strengthen the hands of the Committee as far as it went; and the idea was that the scheme should be formally circulated among all gas companies, with an invitation for their approval.

The President added that it was to some extent a responsible recommendation; but it did not go beyond this.

The resolution was then carried unanimously.

A question having been raised as to the shortness of the time named for the sending in of written approval of the scheme on behalf of gas companies,

The President suggested that a month should be fixed as the limit for getting all the replies in; and this was agreed to.

Mr. Comins proposed a vote of thanks to the Committee.

This was seconded by Mr. F. J. Ward, and cordially passed.

THE EXAMINATIONS IN "GAS ENGINEERING" & "GAS SUPPLY."

List of Successful Candidates.

THE pass-lists for the last examinations in "Gas Engineering" and "Gas Supply" have been sent by Sir Philip Magnus (the Superintendent of Technological Examinations to the City and Guilds of London Institute) to the Institution of Gas Engineers; and Mr. W. T. Dunn has handed them to us for publication. It will be recalled that the announcement was made by the Council in their report last year that the City and Guilds authorities had consented that in future the results should be communicated to the Institution as soon as possible after they had been ascertained.

GAS ENGINEERING.

FINAL GRADE.

First Class.

Adcock, Hubert P.
Baker, Allan
Belton, Francis W. J.
Bennett, Edward W.
Britton, Alfred B.
Broadbridge, Norman P.
Clarke, Harry W.
Crowdy, Thomas
Culbertson, Robert B.
Davey, William E.
Dean, Fred
Dickson, James
Gregson, James
Hailstone, Harold J.
Hay, Stephen
Healey, John T.
Howes, Frederick N.
Livesey, David T.
Luff, Edward J.
Lupton, Henry P.
Macintyre, Donald M.
Marsden, Arthur
Morrison, Eric W.
Myhill, Alphonse R.
Phillips, Arthur T.
Priestley, John T.
Roberts, Arthur R. W.
Scott, Archibald
Smith, James C.
Smith, Joseph H.
Swan, James W.
Thornley, James W.
Ware, Frederick H.
West, Sidney A.
Weston, Ronald A.
Wilkins, Walter P.
Wilson, George G.
Wood, James W.
Young, Fred

FINAL GRADE.

Second Class.

Andrew-Marshall, George
Bayley, Frank
Bently, Frank T.
Boyns, Stuart H. W.
Brown, John G.
Brown, William F.
Clarry, Ernest H.
Clegg, James H.
Corfield, Horace V.
Cox, Frank E.
Croxford, Leslie J.
Dean, Harry W.
Denford, Albert J.
Fulton, David
Hardy, Charles A.
Harvey, Thomas A.
Hodgson, Harry
Hornby, John H.
King, Walter G.
Lees, Frank P.
Leighton, Frederic W.
Peel, Fred
Poulson, Thomas H.
Pykett, Frederick
Simpson, Herbert
Strickland, Cyril C.
Tysoe, Harold M.
White, Frederick
Whitney, Alfred C.
Willis, John H.

GRADE I.

First Class.

Allison, Harold
Barratt, Thomas W.
Bell, William
Bevington, Stanley A.
Branson, Daryll J.
Brasington, Frederick T.
Channon, Percival J.
Crowdy, Ronald St. J.
Dumbleton, Harry
Dyson, Thomas
Fuggle, Harry F. W.
Gage, Henry
Hall, Arthur
Harris, Philip
Hester, James D.
Hood, John
Illingworth, Maurice W.
Joiner, Edward F.
Jones, Arthur I.
Knowles, Alexander
Lawson, John P.
Low, Peter
Marshall, William J.
Millington, Percy
Morris, James D.
Nicholas, Ernest L.
Norton, Arthur L.
Onions, Robert E.
Phillips, George C. D.
Pilbeam, Henry T. W.
Prentis, Arthur E.
Ramsden, Reginald
Redding, Arthur H.
Riddell, Keith O.
Shaw, Balmforth
Snape, James E.
Spinks, William L. S.
Townend, Frank S.
Troughton, Joseph E.
Wadsworth, Maurice
Westworth, James K.
Whitworth, Arnold
Williams, Alfred J.
Woolley, Philip L.
Young, Donald

GRADE I.

Second Class.

Badger, Louie M.
Baldwick, Kenneth W.
Ball, William W.
Barber, Christopher
Bateman, Frank
Bates, John W.
Bridge, Harry
Bridger, Henry J.
Bryant, Herbert C.
Bugby, Ralph
Calvert, Eric E.
Cheshire, Eric D.
Chrippes, George F.
Clack, Charles C.
Clifford, Frank
Clubley, Charles
Davies, Peter
Davis, Albert H.
Davison, Henry H.
Doran, Henry
English, Harry
Ford, John E.
Fox, John F.
Gilbert, Sidney C.
Gilbey, Walter D.
Green, David
Green, William
Griffiths, Herbert
Griffiths, Oswald H.
Hames, Ernest
Hinman, Charles P.
Hopper, Frederick E.
Horsemann, John H. G.
Hughes, Edward G.
Humphrys, Ernest C.
Hunt, Edward R.
Illingworth, Charles
Johns, Tom V.
Lamb, Harold
Lawden, Frederick E.
Lea, Herbert W.
Lennox, William J.
Mackwood, Henry H.
MacNay, Cecil H.
Maxwell, Stanley C.
Mould, Percy
Naylor, Norman
O'Shea, John
Oxley, Charles H.
Ponting, Arthur J.
Reed, William H.
Richardson, Percy
Roberts, William A.
Robinson, Joseph
Roper, John
Sandy, Victor L.
Scott, James J.
Scott, John W.
Shewring, Harold
Simmons, Samuel W.
Sumner, Horace R.
Tarn, Thomas T.
Tilson, Hedley V.
Tradewell, Clarence
Vernon, Thomas E.
Walton, Eric W.
Wilkinson, Herbert
Worthington, Frank
Worthington, James T.

GAS SUPPLY.

FINAL GRADE.

First Class.

Allen, James H.
Beal, Harry
Berry, Edwin J.
Brewer, Percival P.
Cadwallader, William E.
Chapman, William A.
Dubery, Stanley L.
Fletcher, William
Fuggle, Harry F. W.
Goodwin, Frederick H. G.
Harrison, Thomas W.
Heathcote, William
Heffernan, John
Higgins, Francis
Hill, Alfred
Hinchliffe, Fred. D.
Imbrie, William J.
Johns, Tom V.
Kerridge, Herbert W.
Keywood, William T.
Norton, Arthur L.
Parsons, Edward
Pawson, Geoffrey
Peel, Fred
Perkins, Leonard

Reed, Ernest E.
Ruff, Edward J.
Sawyer, George
Scaife, Frank L.
Sumner, Horace R.
Taylor, George L.
Turner, Arthur G.
Vardill, William H.
Walters, Bertie H.
Ware, Frederick H.
Wellbeloved, Henry F.
Willis, John H.
Woodfine, Frank E.
Wortley, George W.

FINAL GRADE.

Second Class.

Beal, Charles F.
Blondin, François J. G.
Botwood, Bernard F.
Boyns, Stuart H. W.
Bradbury, Arthur
Campbell, Albert J.
Carney, John
Chant, Arthur G.
Cogger, Sidney
Colman, John W.
Cook, Albert
Cox, Frank E.
Crowther, George
Curtis, George
Curtis, Rennie A. W.
Digby, Edward
Doidge, Percival J.
Duxbury, Rudolph H.
Edwards, Frederick
Farr, Walter E.
Harris, William E.
Hay, Stephen
Hodgson, Herbert W.
Hodgson, John W.
King, Edgar
Luck, James A.
Marsh, Frederick G.
Mayhew, Charles A.
Munro, James R.
Norris, William
Pattrick, Frederic C.
Phillips, George C. D.
Pocock, James W.
Poulson, Thomas H.
Poupard, Clifford C. N.
Pratt, Ernest E.
Prentis, Arthur E.
Richmond, Claude
Roberts, Arthur B.
Sawbridge, George T.
Smith, Joseph H.
Verity, Albert W.
Waterfield, Edwin W.

GRADE I.

First Class.

Allison, Frederick
Anderson, William
Arnold, Stanley H.
Asker, William H.
Bagshaw, William J.
Baker, Charles A.
Baldwick, Kenneth W.
Beebee, Frank A.
Bell, William
Bellamy, Frederick B.
Bellamy, William
Beynon, Frederick H.
Böhringer, Frederick G.
Brady, William
Branson, Daryll J.
Briggs, Richard A.
Brown, William
Buckland, Wilfred J.
Burden, George E.
Busby, Arthur S.
Cæsar, Augustus S.
Campbell, Herbert
Carlton, John W.
Chant, Herbert P.
Clack, Charles C.
Clifford, Frank
Clubley, Charles
Cook, Alfred J.
Cooper, Anthony V.
Cotton, Ernest J.
Crathorn, Albert
Cridge, William H.
Crowder, Thomas
Curr, Thomas
Dallison, Francis H.
Digby, Albert
Eccles, Henry
England, Albert A.
Ennals, John
Foreman, Robert
Foden, Sidney
Frost, Ernest A.
Golding, John
Hailstone, Harold J.
Hall, Henry W.
Hatherley, John
Hearmon, Frederick
Henson, William E.
Hester, James W.
Holmes, Charles N.
Holmes, Edward
Horton, Alfred E.
Houghton, Frederick C.
Howse, Frederick N.
Hughes, Edward G.
Hurst, Edwin
Illingworth, Maurice W.
Inchdon, Albert
Jannaway, Frederick J.
Johnson, John R.
Joiner, Edward F.
Lacey, Norman H.
Leadbeater, Alfred
Lennon, William
Lovesey, Stanley E.
Lower, Andrew
Lupton, Henry P.
Messenger, William T.
Miller, Albert J.
Milner, Alfred W.
Mobbs, Rupert E.
Morgan, John E.
Moulder, James J.
Munslow, Arthur H.
Muir, David
Murray, Ronald
Nalder, Lawrence M.
Nixon, John W.
Parsons, William G.
Pelling, Edgar
Pennell, Harry G.
Peters, Alfred G.
Phillips, Philip D.
Pickering, Percy
Polglase, Stanley M.
Prankard, Alfred C.
Prentice, Benjamin
Richardson, Albert E.
Richardson, Charles
Ringe, Allan
Schmae, George W.
Scott, James J.
Sessions, Thomas A.
Shaw, Balmforth
Sims, Frederick W.
Smith, Arthur L.
Smith, George W.
Snoad, Arthur
Spinks, William L. S.
Squires, Ernest H.
Stapleton, Frank W.
Stoneman, Richard J.
Stringer, Alfred W.
Summers, William
Targett, Albert E.
Thomson, Andrew
Town, John
Townend, Frank S.
Troughton, Joseph E.
Turner, Frederick
Wadsworth, Maurice
Walsh, Patrick
Watmore, Arthur
Watmore, George
Weaver, Richard H.
Webb, Edward A.
West, George W.
White, Hedley G.
Wilkinson, Herbert
Withers, George E.
Worsfold, Frederick J.
Yates, William M.

GRADE I.

Second Class.

Abbott, Herbert
Anderson, Joseph C.
Ayre, Frank
Bacon, Alfred J.
Barron, George E.
Bartlett, Thomas
Bateman, Frank
Bather, Benjamin M.
Beckett, Cyril
Bennett, George P.
Bolton, Willie
Bone, Henry J.
Bryant, Charles M.
Bullenthorpe, Percy S.
Burns, Walter J.
Calvert, Eric E.
Chrippes, George F.
Christmas, Ernest V.
Claridge, Richard H.
Clark, Robert D.
Clarke, Thomas J.
Cronk, Leonard A.
Cuthbertson, Frederick W.
Day, Edward
Devany, Percy
Dieterichs, William
Dyke, Frederick
Easton, Frank
Faithfull, Cecil W.
Ferguson, George S.
Fevyer, Ernest W.
Firth, Fred
Ford, Frederick R.
Fowler, Joseph
Freakes, Alexander J.
Gilding, Frederick
Golding, James
Goodall, Robert J.
Govey, James T.
Greenwood, Thomas J.
Harris, Charles
Harrison, Norman H.
Harrowell, George E.
Hatton, Percy M.
Hayward, Ernest W.
Heilig, Gustav J. O.
Helyar, Ernest
Heuser, Frederick
Hide, Edward
Hitchcock, Arthur
Hitchcock, William A.
Hodgson, Harry
Holman, Frederick J.
Holman, Sidney
Horwood, Henry G.
Hughes, Herbert
Ironside, Alan S.
Jones, Albert E.
Judd, James
Lambert, Horace M.
Lee, Albert J.
Ley, Walter R.
Long, Arthur C.
Lowe, William
Luton, William
MacNay, Cecil H.
Millington, Percy
Morgan, Graeme R.
Morris, William T.
Morrison, James
O'Connell, James E.
Oram, Frederic J.
Owen, Joseph E.
Pennington, Gardner
Perridge, Edward C. W.
Piper, Malcolm
Poll, Walter
Potter, Sidney J.
Purdue, George A.
Revett, Jack
Roberts, Albert
Scanes, Leonard D.
Scott, Norman
Selden, Stephen
Shadbolt, Robert
Shewring, Harold
Sly, Herbert F.
Smith, Robert C.
Southwick, John J.
Sparling, John
Stannard, William S.
Stredwick, Ernest S.
Swan, Edward
Sykes, Harry
Talling, Sidney H.
Telling, Thomas J.
Thomas, Dicker J.
Thomas, Harold F.
Thorburn, Ronald D. V.
Troughton, Frederick C.
Vigor, John G.
Vince, Charles R.
Wallace, William H. P.
Webber, Wilfrid P.
Wheeler, Horace F.
White, Albert C.
White, Albert H.
Wickens, Charles H.
Woodland, Charles R.
Wright, Percy

ELECTRICITY SUPPLY MEMORANDA.

Failures of Cooking Apparatus—Mono-Fuse Cookery Appliances—Expense and Safety—Cookery Miracles—Ultra-Violet Rays and Ultra-Violent Intrinsic Brilliancy—The Corner again Turned at Hastings—Making Use of the Cinematograph.

HEAVILY fall the blows of Mr. A. H. Seabrook, the Engineer and General Manager of the Marylebone Electric Supply Department, when he is angered. He has evidently had some trouble with the failures of electric cookery appliances in Marylebone, or he would never have written with the asperity that he has done to the electrical press in protesting against the economy of fuses in electric cookery apparatus. The manufacturers have been kicked and cuffed by the suppliers of electric current over the question of the provision of cheaper appliances; and the manufacturers respond by making appliances at a cheaper rate by cutting out protection and oven space, and by putting in lower quality material. Mr. Seabrook is up and at manufacturers who dare to attempt to make a profit by economy in their products. Some of them are actually turning out electric cookers, grills, hot cupboards, &c., &c., which are protected by *only one fuse*. Mr. Seabrook is amazed; "Meteor" of the "Electrical Times" is amazed; and consumers have been both amazed and annoyed. That is quite understandable. But far-sighted Mr. Seabrook thinks this mono-fuse business is going to injure the electricity industry by the condemnation of electric cooking. The danger of the single fuse lies not only in the effect upon business but elsewhere; and it positively staggers some of our friends to think of it in the perspective. The irate Mr. Seabrook calls the one-fuse business "folly" not "economy;" and he fancies that economy is not of much consequence at the moment when the electrical industry is introducing electric cooking to the public "in the face of the keenest opposition that any branch of the electric-supply industry has ever had to meet." We thank Mr. Seabrook on behalf of the gas industry for the compliment.

Our friend truly thinks that immunity from failure of the apparatus is of infinitely greater importance than economy; and this can be secured by several fuses—one for each hot-plate, one for the grill, one for the water-boiler, and two for the oven. In the one-fuse cooker it only requires a leading-in wire to temporarily earth, and the whole thing is out of use. Mr. Seabrook knows how many are the pitfalls for failure of electric current between the engine at the generating-station and the points of use on the premises of the consumer; and he does not want them multiplied and danger increased by a one-fuse standard for electric cooking apparatus. "It is madness!" thunders our friend; and he is quite right. Why it can all be avoided at a cost of simply 20s. to 30s.! And this addition when some electricity suppliers are hurling their strongest invective at the manufacturers for not supplying them with cheaper appliances! With a solemnity befitting the gravity of the occasion and position, Mr. Seabrook concludes his monitory epistle by stating that no cooker, grill, or hot cupboard should be permitted on any supply mains without having each circuit properly protected by a fuse. Even a grill as small as 12 inches by 6 inches should be sectionized into two or three, and each one should be fused. Well, well! the protection requisite against the liability to failure in electric-cooking appliances is extensive indeed.

Some of the platform electrical cookery performers who demonstrate with jam tarts, wafers of bacon, and shavings of bread for toasting will be losing their billets if they do not do something a little more sensational. Mrs. Mole and Mr. Napier Prentice, of Felixstowe, can put some of their predecessors in demonstration work quite in the shade—in fact, we feel we ought to treat them with a great deal of deference. Their performances with joints of meat electrically cooked are little short of miraculous. In one case of a joint of rolled ribs of beef, they cooked 6 lbs. 14¾ oz., and only lost 5 oz.—less than 1 oz. per lb. (current consumption approximately 1 unit). In a second case with a similar joint of the same weight, only 2½ oz. were lost—that is, less than ½ oz. per lb. (consumption of current, 0·84 unit). In a 9 lb. 15 oz. sirloin of beef, the loss was 6 oz., or a little over ½ oz. per lb.; the consumption being 1·54 units. A topside of beef weighing only an ounce short of 12 lbs. lost 10¼ oz., or less than 1 oz. per lb.; the consumption of current being 1·5 units. There are other tests; but there is something really creepy and mysterious about these wonderful performances in subjecting joints of meat to baking temperatures, cooking them, and losing so little. We see in the course of a few notes on the published figures that the weight of the gravy was *included* in that of the joint. The cooking temperature we also observe was between 200° and 300° Fahr. in the case of beef, while for lamb it was raised at the end of the time to 450° Fahr. for browning the joint. We have omitted to give the weight for the leg of lamb. It was 4 lbs. 13 oz., and the loss was 5½ oz., rather more than 1 oz. per lb.; the consumption of current being 0·95 unit. Mrs. Mole and Mr. Napier Prentice used a "Lightning" oven. The other varieties of oven will have to look to their laurels, or capture Mrs. Mole and Mr. Prentice, and get them to show how it is done.

"Meteor" of the "Electrical Times" has been reading the report of Mr. E. Treacher Collins on the question of whether, under the conditions in which they will be used, metallic filament lamps for lighting the House of Commons will have any mischievous effect on the eyes of the members; and he fails to find in it the interpretation that the "JOURNAL" puts upon the oculist's findings. It will be remembered that Mr. Collins stated that with a three-power line of defence—or triple glass protection—between the metallic filaments of the lamps and the eyes of the members (one of the protecting lines of glass being of amber tint), there was no danger from the ultra-violet rays and the ultra-violent intrinsic brilliancy of the lamps. "Meteor" cannot see that this is what Mr. Collins means. He has rubbed his visual organs vigorously (which is a bad thing for the said organs), and he has re-perused the report, and yet cannot see any part of it that needs expressing in the way we expressed it. That being so, we would suggest that "Meteor" rubbed up the wrong parts of his organism; and if he could get a little nearer the cerebral part, and could successfully stimulate it, he might see the true meaning of Mr. Collins's report. He should hear some of the illuminating engineers on this subject, and read up the confessions on the point of prominent electrical engineers. Does "Meteor" suggest that incandescent gas-lamps are as rich in ultra-violet rays as metallic filament lamps? Does he suggest that the intrinsic brilliancy of the former is as great as that of the latter? Surely his science is sufficient to save him from blundering stupidly over this point.

Really the ignorance some of our electrical contemporaries display over gas lighting is laughable. Writing on the subject of Mr. Collins's report, the purveyor of "Gossip" in "Electrical Industries" tries to impart a little information to the honourable members of the Legislature. He remarks that no doubt many members of Parliament will wonder why Holophane globes cannot be used with gas-lamps. Then he goes on to enlighten them in the following choice language: "It is one of the initial curses of gas that, owing to the heat and to the necessity of providing a flue, the flame cannot be surrounded by scientific light-diffusers in the same efficient way." That is the reason. That, of course, is the secret of the Holophane Company advertising their wares for gas lighting. If "Electrical Industries" is right, then the Holophane Company are deceiving people. But then we cannot reconcile the argument with a fine display of inverted incandescent gas lighting at the Ideal Home Exhibition with which Holophane shades were used; the combination being the admiration of many visitors. There is too much hearsay about gossip, and not sufficient actual knowledge.

There is jubilation at Hastings; for the Electricity Department has "turned the corner," and has made £90 net profit. It has only made the slip of "turning the corner" on very rare occasions; and whenever it has done so, it has always shown its capacity for reversing by slipping back a great many times the short distance that it has succeeded in getting round the corner. During its existence as a municipal misadventure it has made about £1500 net profit, but it has been more successful at making losses—the total in the same length of career having been over £17,000. The writer of "Flotsam and Jetsam" in the "Hastings Observer" thinks that the turning of the corner is due to the fact that the electricity undertaking has got the plant, and so the generation of additional current only means any extra cost incurred for coal. Of course, a dealer in "Flotsam and Jetsam" cannot know much about running costs of electrical machinery, and about its upkeep, and depreciation. It is so easy to tell a tale to, and it is so easy to obtain credence from, anyone who has no knowledge of these things. But let us suggest to him that he runs round to the Electrical Engineer, and ask him why he does not "take-on" a number of private consumers for lighting until he has his plant in full swing at a little over 0·83d. per unit—the average cost per unit of coal. Look at the profit that ought to be made by bringing down the average costs of the units generated, and by keeping the machinery running! Or rather look at the profit that ought to be made by the application of the principles that the dealer in "Flotsam and Jetsam" devoutly believes in now that a net profit of £90 has again been made. Of course, someone has to pay capital costs; so we suppose the provider of "Flotsam and Jetsam" suggests that it is perfectly fair that these charges should be perpetually borne by the high-priced units, and that the low-priced ones should go scot-free in this matter. However, there is nothing so sensitive as electric undertakings. Their net profit bobs up and down in a truly remarkable fashion—down sometimes so that it is a *minus* quantity. We see that last year Grimsby had a falling off in net profit from £4586 to £2805. The reasons were higher costs of coal and repairs, and a drop in the custom of the railway company. Hastings beware! As stated in our columns recently, Mr. T. C. Ekin, one of the Local Government Board Inspectors, has been calling the attention of the York City Council to a letter from the Board urging the necessity for establishing a depreciation and renewal fund in order to replace obsolete plant. Some day Hastings will have obsolete plant—the same as other electricity stations. Will Hastings have a depreciation and renewals fund ready for the purpose of replacing it? Not by selling units of electricity at a little over fuel costs!

Cinematograph Theatres have long been used by certain gas undertakings for advertising purposes. We see the advocacy of similar use by electricity undertakings. The Hammersmith Borough Council have entered into an agreement with the Shepherd's Bush Empire for the employment of their advertising facilities at a cost of 6s. per week for twelve months.

The Western District Division of the Institution of Municipal Engineers will hold a meeting at Cinderford on Thursday, when "Some Notes on the Use, Misuse, and Waste of Public Water Supplies" will be submitted by Mr. W. Whitehouse.

RESIDUAL PRODUCTS OF GAS MANUFACTURE.

By Charles E. Munroe,
Professor of Chemistry at the George Washington University.

[Extracts from a Lecture delivered at the Gas Centenary Celebration at Philadelphia.]

Taking the coal-gas industry as it has been and now is, it may be noted that the bye-products are gas, coke, carbon, tar, ammoniacal liquor, and spent purifying material, either lime or oxide. In the water-gas industry, tar and purifying material, with a meagre amount of ammoniacal liquor. In the oil-gas industry, lampblack, tar, and spent purifying material for the new Lowe process; and hydrocarbons for the cracked and compressed oil gases. While in the acetylene-gas industry, calcium hydroxide is practically the only product incidental to the reaction other than the acetylene.

From the outset, the commercial and economic value of certain of the collateral products obtained from the chemical reactions which yield coal gas were recognized, and to such an extent that the original organization, whose parliamentary recognition we now celebrate as a significant event in the evolution of chemical industries, was styled the "Chartered Gaslight and Coke Company;" the production of coke by the distillation process employed being apparently regarded by Winsor and his associates as of equal, or nearly equal, industrial importance to that of coal gas. We know that in the last quarter-of-a-century the relative economic importance of the gas and coke obtained from bituminous coal by distillation processes has been, and to-day still is, in many localities or under certain industrial conditions, reversed; and that where bye-product coke-ovens are employed, the coke is the principal product and coal gas is one of the subsidiary products. In bye-product coke making—particularly where gas is supplied to public service corporations for distribution, as is often the case—the other bye-products are substantially those of the coal-gas industry.

Complex and variable as the gaseous products of soft coal distillation are, the tar and ammoniacal liquor which are bye-products are subject to as marked variations in yields or in composition, or both, with differences in the coal used and the processes or devices employed and in their operation, as the gas is, and that these, but more particularly the tar, are the bye-products which have lent special interest to the gas industry, and which in the more recent years have proved to be important factors in its commercial success and in enabling it to maintain its place commercially in the presence of competing illuminants.

Ammonia and its Value.

Of these bye-products the ammoniacal liquor is chemically the simplest, and yet it is complex and variable. It is produced from some of the nitrogen in the coal, and perhaps to a degree, when alkalies or alkaline earths are present, from atmospheric nitrogen entering, or included in the chamber in which the destructive distillation of the coal is effected. Varying with the process employed and its operation, the ammonia content appears in the condensates as carbonate, sulphide or polysulphide, chloride, cyanide, sulphocyanide, and probably in other combinations, from which it is released, to a greater or less extent, by the action of stronger hydroxides, such as calcium hydroxide, in the process of recovery when it is converted into the marketable forms of ammoniacal liquor or ammonium sulphate.

In this latter state of combination, the nitrogen of the coal or the atmospheric nitrogen which has entered into this state of combination has become available for food for vegetation, whereas before it was not so. This forcibly illustrates the correlation of country and city, of agriculture and manufacture, for while the coal remained unmined, its nitrogen content was unavailable as plant food; but when the coal had been mined and employed in the manufacture of gas for city or town lighting, its nitrogen content was not only released from its inert condition of combustion, but brought into such association, through subsequent treatment, as to be available for plant food. To-day a larger part of the available nitrogen necessary for use in compounded fertilizers or for direct use in agriculture comes from the gas industry, or from its closely correlated industry the bye-product coke industry.

In the development of ammonia recovery from coal gas, a rather amusing and curious condition has developed. Originating as the gas industry did in England, this country has maintained its supremacy in the production of bye-products, and when ammonia and ammoniacal compounds from this source began to assume economic importance, there was devised in England a means for ascertaining the quantity of the valued component in a liquor by liberating it from its state of combination, through the aid of calcium hydroxide, and then measuring neutralization with a standard solution of sulphuric acid which had been made up on the scale of Winchester gallons. This method of determining the ammonia content of liquors (known as "ounce strength") was, on its face, obviously fair and equitable, and was shortly afterwards introduced into America. But the difference in measures was overlooked, and the standard sulphuric acid was made up with the United States gallon as the measure; and ever since "ounce strength" has had in the United States a different significance from that which it has had in England. Fortunately the content in real NH_3 or $(NH_4)_2SO_4$ is coming more commonly into use; and the discrepancy of statistics which has existed between different countries is being reconciled.

The vagaries of nitrogen in forming its various associations, from which result the many compounds of nitrogen found in the distillates from coal, from ammonia, and its multitude of substituted amines, to cyanogen with its numerous derivatives, are but one example of the multitude of complex changes and rearrangements of atoms and radical groups which occur during the process of gas making, where the apparently simple method of heating the coal is employed. For, numerous as the nitrogen compounds formed may be, the known carbon compounds are many times greater, since they include not only the many representatives of various known homologous groups of acyclic and of cyclic hydrocarbons, but also many of the oxy, sulpho, and nitrogen derivatives of these hydrocarbons.

Tar and its Products.

Attention has been called to the necessary variations in the composition and character of the gas which must result from the variations occurring in the composition and constitution of the coal used, the differences in the forms, proportions, and character of the devices used in its carbonization, and particularly in the methods employed in the carrying out of the process. But the effects of these many differences are, if possible, more obvious in the tar, which is one result, than in the gas, which is another of destructive distillation. This fact is of prime importance for consideration by the gas-works manager, since tar stoppages are not infrequent sources of trouble in operation which may to an extent be remedied by so conducting the distillation process in any system as to obtain more liquid or less highly carbonized tars. For it is well known, and has long been known, that in this distillation process heavy hydrocarbons or hydrocarbon derivatives of high boiling-points, which have been evolved from the coal by heat, may condense before reaching the hydraulic main, and fall back upon the incandescent coal mass in the retort, or upon the incandescent walls of the retort or other container, where they are cracked, depositing carbon, which appears on the walls as gas carbon, and yielding lighter and more volatile gaseous products, which again pass on to mix with the other gaseous products, but bearing with them some portion of the carbon which has not been deposited to foul the tar.

At the time these splitting-up processes are going on, or nearly simultaneously with them, building-up processes may be taking place; for it is well known that, under conditions such as obtain in gas-retorts or in the gas-making system in practical use, acetylene and acetylene homologues (such as methyl acetylene) polymerize to benzene and benzene homologues (such as mesitylene), which may again be decomposed into simpler products at more elevated temperatures, and which pass partly to the gas and partly, and more largely perhaps, to the tar. It is this complex, vile-looking, evil-smelling, adhesive bye-product which was for long a stumbling-block in the development of gas lighting. Early in the progress of the industry, efforts were made to utilize it; but they proved of so little avail that, when possible, much of it was run off as a waste product into neighbouring watercourses, destroying the fish, fouling the craft floating on the water and the structures bordering it, and giving rise to nuisances in great variety.

But this coal tar, which was despised and rejected by man, which was a burden to the manufacturer, and a nuisance to his neighbours, has, through the researches of the chemist, become a much-valued and highly-considered substance and an aid to the gas industry, which it has helped to maintain and extend, and through which the demand for cheaper gas has partly been met. Its history is filled with romance. The first English patent ever issued relative to the destructive distillation of coal was that dated Aug. 19, 1681, and granted to J. J. Becher and Henry Serle "for a new way of making pitch and tar out of pit coal." At the outset, tar was therefore to be classed as the principal product, with gas and coke as bye-products, of the coal-tar industry. But industrial development took other courses, and the order of importance was reversed, until the production of pitch and tar proceeded on such a scale that, as stated, the gas makers were compelled to dispose of it at almost any hazard and in every possible way; and yet to-day, through another change in industrial development, this tar has become perhaps the most highly-prized, or at least the most intellectually-honoured, of all the products resulting from the destructive distillation of coal.

It is here that the real romance begins. When this blackish, viscous, forbidding-looking tar was examined, it was found to be a storehouse of most interesting materials and of most fascinating possibilities and realizations; for from it there has been obtained the water-white or colourless benzene, and its equally colourless homologues, which possess such pleasant odours, and give rise to compounds of such markedly pleasant smell that the hydrocarbons of which benzene is the initial member have been long since styled the aromatic series.

This is but the beginning of the enumeration of the hydrocarbons present in coal tar; for, besides the benzene series, many of the conjugated derivatives of benzene have been found present, such as naphthalene, fluorene, phenanthrene, anthracene, and many others. Moreover, there have been found, besides ammonia, nitrogen-containing compounds, such as aniline, the pyridines, the picolines, the quinolines and isoquinolines, and many others; sulphur compounds, such as thiophene and the derivative thiophenes; and hydroxy compounds, such as the phenols and the cresols.

This review embraces but a limited number of the numerous compounds which go to make up the material called coal tar. The number and amount of each varies with the source from which the tar is obtained, and the manner and means by which it is produced.

Water-Gas Tar and its Components.

While coal-gas tar has for more than half-a-century played an important part in the chemical development of many countries, water-gas tar, which has been produced, particularly in America, in very large quantities, has until recently been an unutilized bye-product, except in so far as it has been used for fuel, when mixed with breeze, under the retorts or the boilers, or as a source of power in internal combustion engines, such as the Diesel. But, through the investigation directed by Mr. W. H. Gartley, this material, of which we have a very abundant supply, has recently been made to yield its valuable components for use in further manufacture.

Water-gas tar is a very complex mixture of a great many hydrocarbons. The principal commercial hydrocarbons are probably as follows: Benzol, toluol, xylol, naphthalene, methylanthracene, phenanthrene, and, probably in the pitch, chyrcene and pycene. Water-gas tar is formed in the carburettor and apparatus by the contact of the oily vapours used in carburetting with the highly heated chequer brick. Its formation differs from that of coal tar in that the temperature which obtains is moderate and is very exactly regulated, and the time of contact is short and uniform. Furthermore, there is a high percentage of hydrogen present at the start, due to the water gas which is to be carburetted. The free carbon, therefore, in water-gas tar is very low compared with that in coal gas, and its composition is generally more uniform. The oil used for enriching carburetted water gas varies in character from the paraffin-base oils of Pennsylvania and Ohio to the asphaltic-base oils of Texas and California. The presence of the hydrogen in water gas as affecting the formation of the tar is shown by the increased amount of olefines and the smaller amount of tar formed, which is more complex in its nature in the case of water-gas tar than the tar formed by simple decomposition of the oil.

The general differences between water-gas tar and coal tar are that water-gas tar has a low free carbon content; corresponding fractions have a slightly lower gravity; a larger fixed carbon content; absence of oxygenated compounds; and a general increase in methylated derivatives, especially in the higher hydrocarbons—this confirming, in general, Shülze's theory of pyrocondensations at lower temperatures. Water-gas tar varies in character somewhat according to the original character of the oil and to the method of operation of the set, particularly as regards the temperatures carried in the fixing vessels.

The water-gas tar as it leaves the apparatus exists generally in the form of vapour. This is dropped out when the temperature of the gas is reduced in the wash-box, scrubbers, and condensers; and the last traces are removed in the Pelouze and Audouin tar-extractor. A considerable quantity of water is also condensed at the same time; and the mixture of oil and tar is separated by utilizing the differences in specific gravity. The crude tar thus separated still contains considerable amounts of water held in suspension. This is further separated by storage of the crude tar in large tanks, where in time the water separates out to such an extent that the tar will contain not more than 1 or 2 per cent. of water.

The crude tar is distilled in a fire still—that is, one provided with direct fire—and is cut into a number of fractions, such as light oil, creosoting oil, and naphthalene oil. The residue in the still is then worked up, according to the temperature of the distillation, into road compounds and pitches. The naphthalene oil fraction is chilled, and the naphthalene separated out in centrifugal machines. The light oil is washed with sulphuric acid and soda, and then redistilled, in stills provided with dephlegmating columns, into crude benzols, toluols, &c. These are further redistilled to obtain the pure products.

The relations between tars from various sources, as tested in this research, are set forth in the following tables.

Comparative Ultimate Composition of Coal and Oil and Coal Tar and Water-Gas Tar.

	Coal.	Coal Tar.	Oil.	Water-Gas Tar.
Carbon	82·47	89·21	84·28	92·70
Hydrogen	6·01	4·95	13·46	6·13
Oxygen	6·81	4·23	1·41	0·69
Nitrogen	1·88	1·05	0·24	0·11
Sulphur	2·83	0·56	trace	0·37
Heating value, B.Th.U.	15,353	15,708	19,200	17,193

Comparative Distillations of Different Types of Tars.

	Horizontal Retort.	Coke-Oven.	Vertical Retort.	Water-Gas.
Sp. gr. at 25° C.	1·2039	1·1696	1·1302	1·0679
Free carbon, cold CS_2, p. ct.	21·16	9·36	5·83	0·30
Distillation, p. ct. by weight—				
Start to 105°	0·4	1·0	0·1	1·1
105–170°	1·4	0·3	1·1	2·8
170–225°	10·8	10·0	13·9	9·0
225–270°	10·1	12·4	12·5	12·6
270–300°	4·4	4·3	4·9	10·6
300–360°	4·6	3·0	1·5	7·9
Above 360°	20·4	28·0	27·3	30·4
Coke	46·5	40·6	35·5	25·4

Comparative Distillations of Three Types of Materials.

	Asphaltic Oil.		Water-Gas Tar.		Coal Tar.	
Specific gravity	·9177		1·1165		1·2090	
Free carbon	0·22		0·90		19·80	
Distillation—	A.	B.	A.	B.	A.	B.
Start–110°	·32	·9105	·29	·9550	·52	·9862
110–170°	·75	·8215	1·44	·9637	3·06	1 0095
170–235°	6·25	·8436	14·61	·9900	13·39	1·0146
235–270°	23·51	·9604	24·05	1·0188	12·79	1·0357
270–315°	48·00	·8782	15·73	1·0422	10·57	1 0785
Residue	20·27	1·1471	43·31	1·2310	58·92	1·2850

A. Per cent. by weight. B. Gravity.

The next table shows diagrammatically the products now commercially obtained from water-gas tar.

Light oil—

- Crude benzol. . . → Refined 90 p. ct., benzol. → C.P. benzol.
- Crude benzol. . . → Refined 90 p. ct., benzol. → Refined special fraction.
- Crude benzol. . . → Refined 90 p. ct., benzol. → C.P. toluol.
- Crude benzol. . . → Residue.
- ,, toluol . . . → Refined com. toluol. → Refined special fraction.
- ,, toluol . . . → Refined com. toluol. → C.P. toluol.
- ,, toluol . . . → Refined com. toluol. → Refined solvent naphtha.
- ,, toluol . . . → Residue.
- ,, solvent . . → Refined solvent naphtha.
- ,, solvent . . → Residue.
- ,, heavy . . . → Refined heavy naphtha.
- ,, heavy . . . → Residue.

Naphthalene oil—
Naphthalene salts.
Dead oil.
Dead oil.
Creosoting oil.
Road compound.
Pitch.

The Cyanide Recovery Process.

It seems a far cry from the distillation of gas from coal to the extraction of gold from its ores; and yet industries as different as these two are correlated. Nitrogen has been found in coal, and it appears combined in the bye-products in many different ways. Among them it is found in the gas, the tar, the ammoniacal liquor, and, after the gas is purified, in the purifying material, combined with carbon to form cyanogen and cyanogen compounds, such as the ammonium salts, the thiocyanates, and others. A large part of the metallic gold now extracted from low-grade gold ores and tailings is dissolved out by aqueous solutions of the alkali cyanides, which can be operated so economically that in certain localities ores containing so small a gold content as $1 per ton can be worked to a profit.

There have been many methods of cyanide recovery devised. Among them is the Bueb process, used to some extent in America, which consists briefly in scrubbing the gas, before its ammonia and sulphide are removed, with a solution of copperas, whereby ammonium sulphate, which remains in solution, and ferrous sulphide, which remains in suspension, are produced. The hydrogen cyanide and free ammonia in the gas now react with the ferrous sulphide, giving ammonium ferrous ferrocyanide. Some of this may be converted into soluble ammonium ferrocyanide by the reagents present; and to prevent this, the "mud" is either boiled or made slightly acid with sulphuric acid. In either case, the insoluble double ferrocyanide is formed; and the mud changes colour from almost black to light yellow. The final products are an insoluble double ferrocyanide and a solution of ammonium sulphate, which are separated from each other by filtration.

The process has been found to work best at temperatures not exceeding 100° Fahr. Under these conditions, from 90 to 100 per cent. of the total cyanogen is extracted. On a yield of 1¾ lbs. of cyanogen per ton of coal carbonized, equivalent to about 110 grains of cyanogen per 100 cubic feet of gas, the amount of copperas required theoretically is 6·3 lbs., and varies very little from this in practice. The ammonia absorbed in the process is equivalent to from 4 to 4·5 lbs. of ammonium sulphate per ton of coal. About two-thirds of this appears as ammonium sulphate, and one-third as insoluble ammonia in the press cake. The absorption of cyanogen by the Bueb method generally takes place in a standard washer. The gas should reach the washer freed from tar, and at a temperature not over 100° Fahr. The solution of copperas (ferrous sulphate) is run into the outlet end of the washer, where it is first converted into ferrous sulphide and ammonium sulphate. There is a tendency for the ferrous sulphide to adhere to, and build up on, the exposed surface. This would soon clog up the bundles in a "Standard" washer; and for this reason those in the last tray are replaced by large discs attached to the shaft, and spaced about 3 inches apart. But even these gradually clog up, and must be cleaned at times.

In Germany, the mud as it comes from the washers is generally sold to chemical-works. At the Astoria plant of the Consolidated Gas Company of New York, mud is pumped into lead-lined tanks heated to about 200° Fahr., and acidified with sulphuric acid. The addition of acid changes the colour of the mud to light yellow. During this operation, large quantities of hydrogen sulphide are set free; and in order that this shall not escape into the room, the tanks are fitted with vent-pipes, connected to a fan, which convey the gases out of the building. Enough acid is used so that the material is slightly acid to litmus-paper. The mud is again

tested for soluble ferrocyanide with ferric chloride solution on a piece of white filter-paper; and if the blue colour appears, ferrous sulphate solution is added a little at a time until upon being tested there is no colour. This converts all the cyanogen into an insoluble form.

The mud now consists of insoluble double ferrocyanide of ammonia and iron, and a solution of ammonium sulphate with a little ferrous sulphate and very little free acid. This is pumped into filter-presses. After the press is full, hot water is pumped through in order to wash as much as possible of the ammonium sulphate. The wash water, which is a very dilute solution of ammonium sulphate, is used for making up the copperas solution. It is very difficult to wash out the ammonium sulphate. The best results are obtained by finishing the pressing with mud made by stirring up some of the finished press cake with water until it disintegrates. The presses are about two-thirds filled with the neutralized mud from the washers, and then finished with the mud made from the finished cake. In this way the gravity of the liquid coming from the presses is brought down from 8° to 10° to 1° to 2° Baumé before washing with water.

The solution of ammonium sulphate which runs from the filter-presses is neutralized with ammonia. For this purpose some of the mud as it comes from the washers is boiled, and the gases—principally ammonia and hydrogen sulphide—pass into the ammonium sulphate liquor from the presses. This not only neutralizes the free acid, but also precipitates the small amount of iron present. This is necessary, in order to avoid discoloration of the sulphate. The neutralized liquor is allowed to settle, and the clear solution evaporated in lead-lined pans. This solution contains approximately 1 lb. of ammonium sulphate per gallon. The sulphate separates out on evaporation, and is dried in a rotary drier by means of a current of air from a small blower heated by passing over steam radiators before going through the drier. About 2½ to 3 lbs. of sulphate are produced per ton of coal carbonized. The cyanogen cake from the filter-presses has approximately the following percentage composition: Water, 50 to 40; cyanogen, 22 to 28; ammonia, 5·3 to 7.

About 6 lbs. of press cake are produced per ton of coal carbonized. When it first comes from the presses it is yellow in colour; but on contact with air it rapidly turns deep blue, due to oxidation. It is sold to chemical works to be converted into sodium or potassium ferrocyanide. This is done by first distilling with lime, which drives off the ammonia, and forms calcium ferrocyanide. The solution of the latter is filtered from the residue of iron hydrate, and is then treated with sodium or potassium carbonate; forming the corresponding ferrocyanide and calcium carbonate, which settles out. The clear solution is then concentrated, and the ferrocyanide crystallized.

Unfortunately, the demand for cyanides is not yet sufficiently large to warrant the cyanide-recovery process being pushed far.

[Dr. Munroe showed a number of pictures of cyanide-recovery apparatus used in gas-works in America.]

Sulphur-Recovery Processes.

Another bye-product which warrants further consideration is the spent oxide. Material rich in sulphur has been burnt in acid chambers, and it has been proposed for use in copperas making. Two sulphur-recovery processes which have been demonstrated as feasible and operative in the laboratory are now being tested on a commercial scale in the factories—Burkheiser's process being operated in connection with the Flemalle Grande coke-ovens near Liége, while Feld's rival process is being employed at the gas-works in Königsberg. Both aim to produce ammonium sulphate from the ammonia compounds in the gas liquor and the sulphur compounds obtained from the coal. Feld's process is of special interest to the theoretical chemist, from the fact that the formation of the commercial product sought and the saving of the useful matter accomplished are affected through the aid of the tetrathionates and the control under manufacturing conditions of the reactions through which they are formed and those into which they will enter.

Gas Making at the Coal Mine.

It may be admissible for me, in closing, to refer to a scheme for gas making at the coal mine which has interested me much for a long time. I cannot, perhaps, better present the matter than by quoting from an address to the American Institute of Chemical Engineers in 1909:

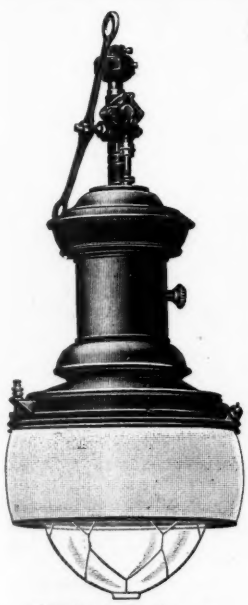
I have long looked upon our present custom of transporting coal long distances to be converted into gas as uneconomic, for a not inconsiderable quantity of coal is burnt to provide the energy with which to haul the coal. Not only that, but, since the gas constitutes but a very small percentage by weight of the coal, there is a considerable waste in hauling the coke, with its ash, and the bye-products. Further, to provide for emergencies, large stocks of coal must be accumulated in advance at the gas-works; and as coal, particularly gas coal, begins to deteriorate as soon as it is removed from the mine, there is a very considerable loss going on all the time from this cause. Further, as the bye-products or residuals are now purchased in the crude state in relatively small quantities at the different gas-works, a large part of their value is consumed in collecting and transporting them to central refineries.

By producing the gas at the mine and conveying it by pipe-line, the cost of haulage of the coke, with its ash, and the crude bye-products is saved. The wastage of coal by weathering is saved, and the cost of collection and transportation of the crude residuals is also saved. Such coke as is not needed for industrial purposes can be converted in producers into gas, which, by means of internal-combustion engines, can be used in generating electricity for distribution; and ash from this coal can be put into the mine for use as a filler in place of coal.

It is evident that gas can, under these circumstances, be made and delivered at a much less cost than is the case at present, though it may be necessary, after long travel, to enrich it near the point of consumption. Furthermore, the valuable areas now occupied by gas plants in our cities can be given up to more concentrated industries, and cheap country lands be substituted for them.

The pertinency of this proposed scheme to the topic given me for consideration lies in the improved opportunity which this plan would afford for the utilization of the bye-products; and I foresee that, should this plan of gas generation at the mine ever be realized, there would grow up about the gas-generating plant a large number of industries based upon the utilization and further manufacture of the bye-products, and that they would be greatly fostered, as would many other industries, by the very cheap gas which could, under these circumstances, be produced for use as a source of heat, power, or light, and which could enter on the spot into competition with water power as a source of electric energy. It is of interest to note that Sir William Ramsey recently gave his endorsement to the suggestion of carrying on the manufacture of gas at the coal mine.

SCREENS AND REFLECTORS FOR INVERTED BURNER LAMPS.

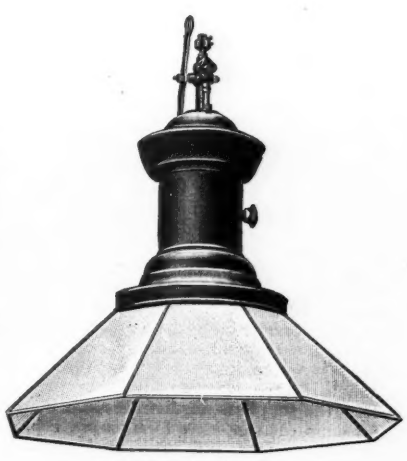


Circular Glass Screen.

We give herewith illustrations of gas-lamps fitted with a new style of opal glass screen devised by the James Keith and Blackman Company, Limited, for use with their inverted-burner lamps of 500 and 1000 candle power.

The opal ring round the globe not only diffuses the light, but permits a considerable volume to pass in an upward direction, where it is utilized for illuminating to a certain extent ceilings and roofs. The screen is ornamental in appearance, and acts as a protector to the globe. The lamp fitted with the ring as shown can be used for both inside and outside lighting.

The firm have also devised a conical opal reflector for inside use only—no globe being required. Though the appliance serves the purpose of an efficient reflector, it allows a diffused light to pass upwards through the opal glass. It can be fitted to lamps of 1500-candle power.



Conical Opal Reflector.

MANCHESTER DISTRICT JUNIOR ASSOCIATION.

Inspection of the Salford Gas-Works and Civic Reception.

The members of the Association who took part in Saturday's inspection of the Salford Gas-Works will have reason to look back upon the event with considerable pleasure. The arrangements made by Mr. W. W. Woodward, the Gas Engineer, and his staff, and the hospitality extended by the Mayor (Alderman H. Linsley) and the members of the Gas Committee, headed by the Chairman (Alderman F. S. Phillips), were such as to make the day one to be long remembered by the Association. In the early part of the forenoon, members assembled at the entrance to the Regent Road Gas-Works, and, numbering over sixty, were divided into two parties for the purposes of the tour of inspection —the first group being in charge of Messrs. Woodward, F. H. Goodwin, and T. Ousey (Superintendent of the Bloom Street works) ; the conductors for the second section being Messrs. H. Shaw (Chief Superintendent), E. Fearns (Assistant-Superintendent), R. H. Garlick, C. E. Teasdale (Assistant Constructional Engineer), and A. E. Bretherton (Indoor Superintendent).

History of the Undertaking.

For the information of those making the inspection of the several gas-works of the Corporation, Mr. Woodward had prepared a short history of the undertaking, together with a brief description of the plant at the different stations. From this one learnt that the manufacture of coal gas in Salford dates back to the year 1804, when Mr. George Lee, of the firm of Messrs. Phillips and Lee, had his house in Chapel Street lighted by gas. The experiment was so successful that in the following year the extensive cotton mills of the firm in the same thoroughfare were thus lighted, the work being carried out under the direction of William Murdoch. It was not until 1819, however, that works for the supply of gas to the public were erected by private enterprise and on a site in Clowes Street. These works were acquired in 1831 by the Police Commissioners, and three years afterwards new works were constructed in Lamb Lane (now called Bloom Street); gas being manufactured there first in 1836. Subsequently, the old works in Clowes Street were abandoned. In 1844, a Charter of Incorporation was granted the town, and the gas-works then came under the control of the Corporation. The works in Lamb Lane were extended from time to time, and sufficed for the needs of the town until 1858. It was in that year that the building of the Regent Road works was commenced. The consumption of gas increased at such a rate that in 1868 it was found necessary to extend; and land was secured in Liverpool Street for additional works—these being commenced during the following year. Again, in 1891 it became necessary to consider the extension of the works; and a plot of land was purchased in Albion Street—building operations being started there in 1893. In 1905, the accommodation at the chief offices in Bloom Street having become inadequate, extensive premises were purchased in Chapel Street; and the Stoves Department was transferred there in 1906. At present, the Corporation supply gas to the borough and the districts of the following authorities: Eccles Corporation, Worsley Urban District Council, Prestwich Urban District Council (part only), Irlam Urban District Council, and the Barton-upon-Irwell District Council (part only). The extreme length of the district supplied is 11¼ miles, and the extreme width 6¼ miles—a total area of about 40 square miles, with an estimated population of 340,000. The total length of the mains, which vary in diameter from 2 inches to 36 inches, is 286 miles. The number of consumers is 70,163, of which 30,068 are supplied through prepayment meters. Gas-cookers to the number of 5372 are out on hire ; the public lamps number 10,035. The make of gas last year was 1,676,389,000 cubic feet; and the total capital expenditure up to March 31 last amounted to £913,868. The four manufacturing stations occupy a total area of about 13 acres, and have a carbonizing capacity of 908 tons of coal per twenty-four hours.

Description of Works and Plant.

The following is a description of the various gas-works of the Corporation.

Bloom Street Works.

The Bloom Street works, at which are situated the chief offices of the Gas Department and the meter-making and repairing shops, cover an area of about two acres, and have a carbonizing capacity of 84 tons of coal per twenty-four hours. The manufacture of gas is, however, only carried on at these works during the winter months. Being the oldest works in the borough, the carbonizing and purifying plants do not present any features of special importance. The station meter has a total measuring capacity of 50,000 cubic feet per hour. The gasholders, which are three in number, have a total storage capacity of 894,000 cubic feet. There are two 30-inch station governors, which control the pressure to the Broughton district and to a portion of the Salford district. As the districts supplied through these governors require a much larger quantity of gas than is made at the Bloom Street works, the supply is augmented from the Liverpool Street works, by means of a 24-inch high-pressure main connecting the two works. The most interesting and modern portion of the works is the meter department, where the Corporation have for some years carried on the manufacture of consumers' meters.

Regent Road Works.

The Regent Road works, which are situated on the south side of the London and North-Western Railway, near Cross Lane Station, cover an area of about 3¼ acres, and have a carbonizing capacity of 240 tons of coal per twenty-four hours. There are two retort-houses, containing together 212 through Ω-shaped horizontal retorts. In the larger of the houses the work of charging and drawing the retorts is effected by hydraulic machinery of the "Foulis" type, fitted with West's scoops. The coal for use in this house passes directly from the railway waggons into coal-breakers, where it is broken to a convenient size. It is then elevated and conveyed to the charging-machines by gravity-bucket conveyors. The hydraulic power required for working the machines is obtained by means of a pair of high-pressure horizontal steam-engines driving two differential ram pumps. The coal breakers and conveyors are driven by two high-pressure horizontal steam-engines. The condensers are of the horizontal type; the bottom tier of pipes being immersed in a tank of water. The exhausters are of the horizontal reciprocating type, and are capable of passing 160,000 cubic feet of gas per hour. There are two washers and three tower scrubbers. The purifiers are six in number, each 30 feet square by 6 feet deep. The covers are lifted by means of screws worked by worm and wheel gearing. The three station meters here have a combined measuring capacity of 120,000 cubic feet of gas per hour. The two telescopic gasholders have a total storage capacity of 2,279,000 cubic feet. There are three station governors—one 30-inch, which controls the pressure to the Eccles district, and two 24-inch, which control the pressure to the Ordsall and to a portion of the Salford district.

Liverpool Street Works.

The Liverpool Street works, which are situated on the north side of the London and North-Western Railway, near Cross Lane Station, are connected with the Regent Road works by a foot-bridge. The works cover an area of about 6¼ acres, and have a carbonizing capacity of 314 tons of coal per twenty-four hours. There is one retort-house containing 224 through Ω-shaped horizontal retorts. The retorts are charged by electrically driven stoking machinery of the "De Brouwer" projector type. The coal required is supplied in railway waggons, which are lifted from the siding level on to the elevated railway over the coal-stores by two 20-ton hydraulic waggon hoists. [The power required for working these hoists and the other hydraulic machinery used on the works is obtained by means of two pairs of high-pressure horizontal steam-engines, driving two pairs of differential ram pumps.] The coal is discharged from the waggons into coal-breakers, where it is broken to a convenient size. It is then elevated and conveyed to overhead storage hoppers, spaced at about equal distances along one side of the retort-house. From these storage hoppers the coal is dropped into the hopper of the charging-machine as required. The retorts are discharged by an electrically driven telescopic ram of the "Jenkins De Brouwer" type. The coke falls from the retorts on to a "De Brouwer" coke-conveyor, which runs in front of the retort-bench on the opposite side to the stoking machinery. The coke is carried by this conveyor to the end of the retort-house, where it is quenched, elevated, screened, and deposited into hoppers. In addition to the stoking machinery, the coal and coke handling plant is electrically driven; the current being supplied by a Mather and Platt 50 kilowatt generator direct coupled to a high-speed gas-engine. The condensers are vertical —one set being of the atmospheric type and the other set of the water-tube type. There are two pairs of rotary exhausters, each pair capable of passing 160,000 cubic feet of gas per hour. There are four tower scrubbers, and three rotary washers. The purifiers are twelve in number, in two sets of six boxes each. The boxes in the first set are 24 feet square by 6 feet deep, with covers lifted by hydraulic rams. The second set are 28 feet square by 6 feet deep with covers lifted by rope driven travelling cranes. The two station meters have a total measuring capacity of 200,000 cubic feet of gas per hour. The two telescopic gasholders have a storage capacity of 3,942,000 cubic feet. There is a 24-inch station governor, which controls the pressure to the Pendleton district. The sulphate of ammonia plant, which deals with the liquor produced at all the works, is capable of turning out about nine tons of sulphate per twenty-four hours. The total quantity manufactured per annum is about 1800 tons. The water required for cooling the gas, quenching the coke, and for use in connection with the sulphate plant is obtained from an artesian well. The boring is 500 feet deep, and varies from 26½ to 15 inches in diameter. The pumping is done with a single-acting lift and force pump, having a capacity of 10,000 gallons per hour. The pump is driven through helical gearing by a horizontal high-pressure steam-engine.

Albion Street Works.

The Albion Street works, which are situated at the junction of Albion Street with Liverpool Street, are connected with the Liverpool Street works by a subway, and have direct railway communication with the Lancashire and Yorkshire and the London and North-Western Railways. The works cover an area of about 1½ acres, and have a carbonizing capacity of 270 tons of coal per twenty-four hours. There is one retort-house containing 224 Ω-shaped inclined retorts. These retorts are built at an angle of 32 degrees. The coal falls from the railway trucks into coal-breakers below, and after being broken is transported, by

means of elevators and conveyors, into large storage hoppers placed above the retort-benches. Small three compartment hoppers of the "Shoubridge" type, which travel on elevated rails in front of the retort-benches, convey the coal from the large hoppers to the retorts as required. The coal breakers, elevators, and conveyors are driven by two gas-engines. The coke is discharged on to De Brouwer coke-conveyors, which run in front of the retort-benches. The coke is carried by these conveyors to the end of the retort-house, where it is quenched, elevated, screened, and deposited into hoppers. The coke-conveying machinery is driven by a gas-engine. The gas manufactured at the Albion Street works is purified, measured, and stored at the Liverpool Street and Regent Road works.

The Stoves Department is housed in premises situated at the junction of Bloom Street with Chapel Street. The building covers an area of 170 square yards, and is three storeys high. Large well-lighted show-rooms are provided on the ground and first floors, where consumers may inspect the latest designs in gas appliances. There are also branch show-rooms in Eccles and Swinton.

Reception and Luncheon at the Town Hall.

When the inspection of the works had been completed, the members of the party were conveyed in special tramway cars to the Salford Town Hall, and in the Council Chamber the Mayor of the Borough, accompanied by Alderman Phillips, the Chairman of the Gas Committee, held an informal reception. Subsequently an adjournment was made to the Banqueting Hall, where luncheon was served. At the top table the Mayor was supported by Alderman Phillips.

Alderman PHILLIPS, in proposing the toast of "The Manchester and District Junior Gas Association" on behalf of the Salford Gas Committee, desired to couple with it the name of Mr. Hollingworth, the President, who was a friend of his. It was an agreeable duty for the Mayor and himself and colleagues on the Gas Committee to receive the members of the Junior Gas Association there that day, chiefly because they recognized that the Association was engaged in a work which, in a few years—no one knew how soon—would bear good fruit, to the advantage not only of the members but also of the community, of which they in Salford formed a part. It had been his intention to have told them that in coming to Salford they were in a town where one of the earliest gas-works in the kingdom was erected; but that had been dealt with by their excellent Engineer, Mr. Woodward. Now, although they had had gas in Salford for considerably over 100 years, and its use had been extended throughout the length and breadth of the land, he ventured to make the statement that very few of the community to-day knew very much about gas and its uses. In fact, the bulk of the people, he ventured to say, knew very little about it. The amount of ignorance that existed with regard to gas was really startling, and rather upset one at times. For instance, a man said to him one day: "Your gas in Salford is bad." He asked the gentleman why he made it out that the gas was bad; and the startling reply was "Because it jumps." [Laughter.] This was merely an illustration of the need there was for a little more knowledge on the subject among users of gas. He assumed that it was because gas gave so little trouble that people as a rule paid no attention to it, and expected everything from it. There was great need, in his opinion, for the education of the consumer as to the possibilities of gas and how to get the most out of it in its consumption. Speaking in the presence of those who would in the future be called upon to fill important positions in the gas profession, he said there was a very big field before them yet for experiment and the advancement of the industry. As Chairman of the Salford Gas Committee, he considered there was an immense field for them and a great future for gas in spite of all other illuminants. They had not got to the end of the possibilities of gas by any means—indeed, he did not know whether there would be any end at all. The last experiments of Professor Bone at Leeds, for instance, had opened up a new field; and what it was going to lead to he did not know. In the Junior Gas Associations there were many possibilities for the future; and therefore he and his colleagues on the Gas Committee looked upon it as a duty to do what they could for the encouragement of the Manchester Association in the work it was doing. It was with great sincerity he proposed the toast of "Continued Prosperity to the Manchester and District Junior Gas Association." It was an additional pleasure to him to couple with the sentiment the name of their President. He had had the advantage of knowing Mr. Hollingworth for some considerable time, as he was an official under the Corporation. Although his departure was a loss to the Gas Department of the Salford Corporation, he hoped it was to the advantage of Mr. Hollingworth, and he looked forward with confidence to a further development in his career.

Mr. HOLLINGWORTH, in responding, said that, as President, he desired to convey the sincere thanks of the members of the Association to Salford for having invited them to view the gas-works, and for the hospitality that had been extended to them. He remarked that Alderman Phillips must be regarded as a bright ornament in the gas industry; for, as Chairman of the Salford Gas Committee, he had done a great deal for its advancement. If ignorance did exist as to the gas industry among the general public—and no doubt it did—it was not the fault of Alderman Phillips, because he had taken every opportunity, and every possible chance, to speak in favour of gas and point out its possibilities. They were much indebted to him for what he had done for the gas industry—they were indebted to him for many things, and not the least was the important part he took in keeping alive the publicity movement. If Alderman Phillips had done nothing beyond that, his services in this direction entitled them to rank him among the benefactors to the gas industry. Mr. Hollingworth also referred to the support which Alderman Phillips had given the Junior Gas Association in the University scheme.

Mr. J. M'NICHOLL (Warrington) proposed "The Mayor and Corporation of the County Borough of Salford." His chief point was that these visits to different gas-works were of the greatest educational value to the members of the Junior Association, and therefore they much appreciated the facilities given them for the inspection of the different stations of the Salford Corporation Gas Department.

The MAYOR, in replying, said they did not have many conferences in Salford, but when they had they professed to "do it well." They were proud of their Chairman of the Gas Committee, proud of their Engineer, and proud of their gas undertaking. He hoped that the result of the visit would be of benefit to the members in their calling and of benefit to the industry in general.

Alderman SNAPE also spoke. He agreed with the Chairman of the Gas Committee that gas had not yet reached its finality, and that there was room for research. The days of management of gas undertakings by "rule of thumb" had gone, and the successful gas engineer was the man who had had a thorough scientific training, combined with a practical knowledge of the work he had to do.

Mr. W. L. HEALD (Preston) proposed a vote of thanks to the Chairman and members of the Salford Gas Committee, and this was seconded by Mr. J. ALSOP, who recalled the fact that the Salford Corporation was the first to contribute to their University Lecture scheme.

Alderman PHILLIPS, in replying, remarked that it would have been impossible for him to have done what he had for the gas industry had it not been for the loyal and intelligent support he had received from the members of the Gas Committee. In this connection, he could not leave out Mr. Woodward and his staff—all being prompted by a desire to do their best for the undertaking and for the advancement of the industry in general.

A vote of thanks was passed to Mr. Woodward and his staff on the motion of Mr. F. THORP, seconded by Mr. A. L. HOLTON.

Mr. WOODWARD, in his response, said it had been a matter of gratification to him to have the opportunity of showing members of the Junior Association over the works; and if they had gained in knowledge as a consequence, he was delighted. It was also gratifying to him to know that his assistants took an interest in the Association, and to have been able himself to help them with the University scheme. He believed that great advantage was to be derived from these University lectures in the future. It had been said by some that the lectures were above the heads of a good many of the members of the Association. He did not believe it for a moment. Every member who attended these lectures was, in his opinion, bound to come away with some knowledge and some ideas that he did not have before. Having paid a tribute to Alderman Phillips, he said he was glad his assistants had been mentioned in the vote of thanks. He had an excellent staff, and desired to acknowledge the loyalty and help he got from them.

This concluded the proceedings at the luncheon.

The Business Meeting.

A business meeting was held subsequently in the Council Chamber, Mr. HOLLINGWORTH being in the chair. A paper was read by Mr. E. Fearon, of Salford, who had for his subject "Some Notes on Carbonization." [The paper, together with the discussion to which it gave rise, will be found on p. 898.] After a vote of thanks had been tendered to the author, on the motion of Mr. J. BRIDGE, seconded by Mr. R. H. GINMAN, the proceedings concluded.

SEPTIC-TANK GAS FOR POWER.

About twelve months ago, a proposal was made by the Department of Public Works, New South Wales, to use for lighting purposes the gas generated at the Parramatta septic tanks. These are three in number, but only two are in daily use; the third being retained as a stand-by. Each tank is 30 ft. by 95 ft., with an average depth of water of 7 ft. 6 in. The sewage is domestic; the quantity of trade waste being so small as to be negligible. A large quantity of gas is generated, and is stored in the space between the water and the covering of the tank; the height of this portion of the chamber being 2 ft. 6 in. The practice has hitherto been to burn off this gas in a large bunsen burner. The first proposal was to force the gas into a holder, and burn it in an incandescent burner; and with this view a portable 4 H.P. petrol engine was procured to ascertain if the gas had sufficient calorific value to allow of its use for motive power to drive a fan or an air compressor. In his last annual report, Mr. L. A. B. Wade, the Chief Engineer of Irrigation, states that, after adjusting the valves, the engine ran without a load as smoothly with the tank gas as with petrol gas. The tank gas appeared to be clean; no dirt being left upon a white surface exposed to the exhaust.

As the Municipal Council's Engineer preferred to instal a dynamo, and employ electric light, the experiment of using the tank gas as an illuminant was not proceeded with. The Council have put in a Hornsby engine, which is developing 10 H.P. and driving a dynamo supplying current at 100 volts for 85 lamps of from 16 to 32 candle power. The engine is stated to be running steadily with the gas-valve only slightly open; and there would appear to be an ample supply of gas for a much greater power.

At the Church of St. Peter and St. Paul, Wing, Rutland, on the 6th inst., Mr. C. F. Broadhead, the elder son of Mr. James Broadhead, of Grimsby, and till recently Engineer and Manager of the Middleton Gas Works, was married to Miss Annie Bygott, the elder daughter of Mr. and Mrs. William Bygott, of Rye Hill, Wing. Mr. C. Rhodes Armitage, of Morecambe, was the best man. Mr. Broadhead, it may be remembered, has been appointed Engineer and Manager of the Brisbane Gas Company; and he and Mrs. Broadhead start on the 24th inst. for Australia.

SOME NOTES ON CARBONIZATION.

By E. Fearon, of Salford.

[A Paper read before the Manchester and District Junior Gas Association, June 15.]

The old maxim that "profits are made and lost in the retort-house" still holds true to a very great extent; and it is certain that too much attention cannot be paid to the proper carbonization of the coal at our disposal.

During the last ten years or so, the illuminating power fetish has practically received its death blow, and most undertakings are now supplying what would have been considered low-grade gas at the beginning of the century. Ten years ago, a glance through the returns of the various undertakings showed that, in many cases—especially in the North—an illuminating power of 20 candles or so was not uncommon; while in Scotland, some of the biggest works were supplying 20 to 24 candle gas. Edinburgh even was as high as 24½; and many of the smaller works were sending out gas of anything from 24 to as much as 34 candle power. But this has been very much altered since then, and out of the 1245 gas undertakings given in the "Gas World Year Book" for England and Wales, only some half-dozen now supply 20-candle gas or over; and they are all quite small places. Scotland has still a good many towns supplied with gas of over 20-candle power; but it is significant that the large towns—such as Aberdeen, Dundee, Edinburgh, Glasgow, Paisley, and others—have all considerably reduced their illuminating power, in some cases as much as 7 candles. Glasgow now supplies 18, and Edinburgh 17 candle gas. The reason for this, of course, is not far to seek. Since flat-flame burners, with their efficiency of some 2 or 3 candles per foot, have been superseded by modern high-efficiency incandescent burners, mere luminosity has ceased to be all-important; and the only quality demanded of town gas is that it shall have a fairly high calorific value and a high flame-temperature. Thus new methods of manufacture are being evolved, and the whole subject of carbonization is literally a "burning question."

Before proceeding any further, I should like to refer briefly to the Salford Gas-Works, which you have visited this morning. So far, owing to our high illuminating power standard, which has to be strictly maintained (as the gas is independently tested in the out-districts, in two places at a distance of about 4 miles from the works), we have not been able to take full advantage of modern conditions, and cannot therefore show any phenenomal yields; but taking everything into consideration, we get the most possible out of the coal with which we have to deal. The make for the year works out at about 10,300 feet to the ton, with an illuminating power of 19·25 candles, as tested in the Salford argand; the calorific value being about 640 B.Th.U. gross.

The bulk of the gas is made at our Liverpool Street and Albion Street works, in horizontal and inclines respectively. The horizontals are charged by a "De Brouwer" projector, and discharged by a telescopic ram of the "Jenkins-De Brouwer" type. They carbonize 7 cwt. per six hours, and the inclines 6 cwt. in the same time. It is difficult to give comparative working costs, as so many factors must be taken into account—such as the standard of wages paid, whether all the men employed in handling the coal and in actual carbonization are included, and so on. But including all the men who have any part in dealing with the coal from the time it enters our sidings till the coke is loaded into waggons or carts—including the retort-house foremen, boiler and engine men, and coal and coke hopper men—the horizontals cost practically 1s. per ton of coal carbonized, the inclines 1s. 4d.

To return to the subject in hand. It is evident that a great deal of research work is necessary before carbonization can be called a really scientific process, as no one, apparently, can say just what is the correct temperature to secure the best results. In any intermittent system, where a charge of coal is "dumped" into a retort, allowed to remain a certain time (irrespective of the character of the coal), the resulting coke withdrawn, and another charge of coal introduced, the carbonization proceeds at varying temperatures, and varying quantities of gas, of varying quality, are given off. Supposing just before a retort is charged, its temperature is (say) 1800° Fahr., then, as soon as the charge is introduced, the temperature will probably fall to 700° or 800° Fahr., and gradually rise again to the former 1800°. So that gas is being evolved at all sorts of temperatures, and the result of this is great variation in the make and quality.

Taking the customary six-hour charge in horizontals, some 14 per cent. of the gas is given off in the first hour; and, within limits, this will be rich in hydrocarbons and marsh gas. In the next hour-and-a-half, about 50 per cent. of the gas is evolved, with a diminution of hydrocarbons and marsh gas, and a corresponding rise in hydrogen. And so on to the end, when the gas is almost composed of hydrogen and marsh gas, and a fairly high percentage of nitrogen. The calorific value also varies a good deal, there being a difference of 12 to 15 per cent. between the highest and lowest results.

Several engineers have gone into the question of heavier charges and longer periods of distillation in horizontal retorts; and it is evident, from the results published, that a great improvement may be effected with existing settings. Mr. J. Ferguson Bell, of Derby, read a very interesting paper on the subject before the Institution of Gas Engineers some time ago, from which I have extracted the following figures:—

Duration of Charge. Hours.	Weight of Charge. Cwt.	Gas Made per Ton. Cub. Ft.	Candle Power. No. 2. Met. S.C.	Sperm Value per Ton. Lbs.	Cal. Val. per Cubic Foot. Net.
6	6	10,594	16·31	592	538·8
8	7¾	11,245	15·59	601	518·9
10	9½	11,499	14·53	574	488·4
12	11½	11,463	14·77	580	484·4

The ammonia produced increases directly with the heavier charges, being as follows:—

6 hour charges	7·26 lbs. NH_3 per ton.
8 " "	8·26 " " "
10 " "	8·45 " " "
12 " "	8·50 " " "

So also as regards tar, which rises from 10·64 gallons per ton with six-hour charges, to 12·84 gallons with twelve-hour charges.

At Longton, for the year ended March 31, 1911, a make of 12,953 feet per ton, with an illuminating power of 15·82 candles, and a calorific value of 540 B.Th.U. per foot, was obtained with horizontals. Numerous other examples could be given; but it is not necessary to trouble you with them, except to point out that there are still great possibilities of high yields, and increased amount of residuals, with existing plants. In fact, taking the case of Longton, the net calorific value per ton is 7,020,000 B.Th.U., almost equal to anything the vertical retort can show.

The case of inclines is rather different. The higher initial cost, and high working costs, rather put them out of court; and no great advance is to be looked for there, as far as one can see.

Coming next to the question of carbonization in "bulk." This, in England, so far as gas-works are concerned, has lagged a long way behind Continental practice—due, most probably, to the higher illuminating power of gas demanded by Parliamentary Committees. In Germany, more especially, illuminating power is hardly considered at all—8 or 10 candle power being regarded as quite satisfactory, so long as the calorific value is somewhere about 550 B.Th.U. per foot; and in that country chamber settings and vertical retorts are being erected very rapidly. On the Continent generally, the chamber setting, either inclined or horizontal, is at present an easy first where new plant is being erected. But, so far, these settings, which carbonize some 5 or 6 tons per chamber per day, have not found favour in England.

Some of the German industrial towns are even supplied with coke-oven gas; and a company has been formed for the purpose of supplying a combination of towns with gas direct from the collieries. This, perhaps, is an indication of what may come to pass in all civilized countries possessing coalfields—gas being made in huge quantities at the colliery, and distributed to towns 40 and 50 miles away. No doubt, a cheap supply could then be looked for.

The best known system of vertical retorts on the Continent is, probably, the Dessau. It has already gained a footing in this country; and at Sunderland an installation of sixty retorts has been working since December, 1909—quite long enough to give a good idea of what this type of plant is capable of. Mr. C. Dru Drury, the Engineer of the Sunderland works, in a paper read before the Institution of Gas Engineers last year, gave particulars of the plant; and as the figures are instructive, I have abstracted the following.

The ground space occupied by the bench is 90 ft. by 17 ft. 6 in. = 2·1 sq. ft. per 1000 cubic feet of gas made, or (say) 27 sq. ft. per ton of coal carbonized per day. The retorts are 13 ft. 1½ in. long; the section at the top being 9 in. by 22½ in., tapering to 13¾ in. by 27½ in. at the bottom. Each retort carbonizes about 19 cwt. per day.

The working results for the year ended March, 1911, are given, also those from horizontals using similar coal, as follows:—

	Verticals.	Horizontals.
Coal carbonized, tons	20,349	71,069
Weight of coal per charge, cwt.	9·54	6·0
Gas made per ton, cubic feet	12,647	10,638
Illum. power (No. 2 "Met."), candles.	15·52	18·22
Calorific power per cubic foot, net	531	545
Tar per ton, gallons	11·40	10·34
Sulphate per ton, lbs.	28·66	24·07

It will be seen that there is an increase of 2009 cubic feet of gas, 1·06 gallons of tar, and 4·59 lbs. of sulphate per ton of coal carbonized. But perhaps the most important point is the increase in thermal units per ton obtained from the verticals, which is about 16 per cent.

The retorts are charged every twelve hours. This includes steaming for two hours towards the end of the charge; the steaming appearing to give an increase of about 1000 cubic feet per ton, with some decrease in illuminating power, but none in the net calorific value. The tar produced is light and thin; the amount of free carbon being only 4 per cent., compared with 17 per cent. in tar from horizontals, using similar coals.

Of vertical systems of British origin, the best known are the Glover-West and the Woodall-Duckham; and at the Droylsden works of the Manchester Corporation there is an installation of the former, consisting of two sections of eight retorts, which gives great satisfaction. The retorts are oval in section, and measure 30 in. by 10 in. at the top, enlarged to 36 in. by 22 in. at the bottom, and have an over-all length of 20 feet; each retort being able to carbonize from 2½ to 3 tons of coal per day. The nominal output for the two settings is 500,000 feet a day, but as much as 630,000

feet have been made. The retort-house is 56 feet long by 44 ft. 6 in. wide, giving an area of 2492 square feet, equal to 55 square feet per ton per day, against from 70 to 90 square feet with horizontals or inclines.

Several tests have been made with the plant; and as the Droylsden works are self-contained, and only the verticals are in operation, it has been possible to test the installation under very severe conditions. With Lancashire coal, a make of 13,030 cubic feet of 15·4 candles was obtained; Yorkshire coal giving 14,236 cubic feet of 15·35 candles, and Derbyshire coal 14,258 feet of 15·38 candles. The B.Th.U. per ton are particularly high; being 7,804,175 in the case of the Yorkshire coal, and 7,191,609 with Lancashire coal. The fuel account is very low; being only 9·37 per cent. with the Lancashire coal, and 10·39 per cent. with the Derbyshire.

As one man can attend to everything inside the retort-house, the labour costs inside the house are remarkable low—4·2d. per ton; and no doubt this could be reduced on a bigger plant. The coke produced is bright and clean; and as it leaves the retort almost cold no quenching is required, so that it is, of course, quite dry, which should give it an increased market value.

The Woodall-Duckham system is, more or less, on the same lines; but the retorts are longer, being 25 feet, and formed of bricks, grooved and tongued, to prevent leakage at the joint, and panelled out at the back so that the heat can readily pass through the walls to the charge in the retort, and a large surface is presented to the heating gases in the flues. The heating of the retorts is from the top downwards—*i.e.*, the producer gas is admitted at the top of the setting, and, after mixing with the secondary air, passes down to the main flue. Other structural details—such as the coal-feed and coke-extractor—are different. But in both plants the carbonization is continuous, and may be called fractional distillation, since the gases in passing to the top of the retort do not have to go through a hotter mass of material than that from which they are given off.

The speed at which the coal travels through the retorts can be easily regulated, so that different coals can be carbonized under the conditions most suitable to them, and rich or poor gas produced as desired—the flexibility of the plant being one of its many strong points. In fact, gas manufactured in vertical retorts is gas-making *de luxe*. There is a complete absence of smoke or steam, and the attendant (one can hardly say stoker) would seem in danger of suffering from boredom, so little has he to do.

The heating arrangements are particularly good. There is very little waste, even the coke being made to yield up its share by heating the secondary air. The small amount of machinery required (and none of it complicated or quickly moving) is a great advantage, especially on small or medium-sized works, where the services of a number of fitters are not available at a moment's notice, as is the case on a big works.

The advantages, then, of the vertical system may be summed up as follows: Small ground space required; increased make and calorific value per ton; low labour costs; improved coke; economy in fuel; flexibility of plant; absence of smoke and steam.

No doubt there are disadvantages; but, as far as I can learn, all who have had experience of the modern settings are most enthusiastic in their praise of them, and look with pity on their unfortunate brethren condemned to struggle along with the older methods. Installations are being erected, not only in Great Britain, but in Australia, Japan, Norway, Sweden, and other countries, which illustrates the adaptability of the plant to various sites and local conditions.

Altogether, it seems as if the dream of continuous carbonization has at last come true, and the other dream of purification in closed vessels may follow suit. But, fascinating though it may be to think of the time when a gas-works will be almost as clean and neat a place as an electric generating station, the majority of works will, for some years to come, have to make the best of the methods in vogue at present.

In any case, the proper heating of the retorts is, of course, all-important, as not only is the maximum yield of gas obtained from the coal, but the "wear and tear" expenses are greatly reduced by careful and even heating, and the quality of the gas produced is kept more constant.

Frequent analysis of the producer and flue gases, though highly desirable, is almost impossible on a big works; but a good deal can be learnt from careful analyses carried out on one bed. From the data obtained, the slides and dampers of the other ovens can be approximately set, and the final touches given by daily observation. Then, also, the varying qualities of the coal, and the resultant coke, must be taken into consideration, as some coals require a higher carbonizing temperature than others, while coke varies in density and percentage of ash. Periodical observation by means of a pyrometer will prove of great advantage; the Féry spiral being handy and fairly accurate.

My own practice is to take the temperature of the combustion chambers by a Féry several times a week, and to see the condition of the coke from a charge each day. By this means, it is possible to keep the settings up to "concert pitch," and it also enables one to see that no holes or cracks are left in the retort without attention. As a rule, the average temperature in the combustion chamber of the horizontals is about 2450° Fahr.—sufficient to thoroughly carbonize the 7 cwt. charge.

It is impossible to give any universal rule as to the working of different settings; but it is necessary in all cases to maintain a good depth of fuel in the producer, and to see that the coke is levelled each time the producer is charged; otherwise it is apt to get thin at the back, resulting in the production of a poor gas, containing a high percentage of carbon dioxide. The flue should be periodically examined and cleaned out, and, if necessary, all cracks filled up. The nostril holes should also be examined each day to see they are free from any obstruction. With regard to the draught, this should be as low as possible, the products of combustion being allowed to flow slowly through the setting, so as to give up the maximum amount of heat to the retorts.

The subject of liming coal before carbonization has been revived by the experience gained at Cheltenham. This was tried, at first, to lower the sulphur compounds; and it was successful. But, according to Mr. Paterson, other benefits were found, such as the less number of stopped ascension-pipes, an increase in the make of 800 feet per ton, and a slightly better yield of sulphate. There seems, however, to be some doubt as to whether the coke is affected. But perhaps someone present may have tried this process, and can give us the result of his experience.

Whatever the quality of the gas to be supplied, one of the greatest essentials is uniformity; and undoubtedly this is more easily attained with a low than with a high grade gas. For instance, at Edinburgh, some years ago, when 25-candle gas was being made, it was found that in travelling through the mains from New Street to the Glenogle Road gasholder station, a distance of 1¼ miles, during the winter period from November to February there was a loss of 4·7 candles. The Leith gas, in travelling a distance of 1·8 miles, lost 5¼ candles. Now a gas of 15 to 16 candle power, tested by the No. 2 "Metropolitan" burner, would, I think, travel a good deal farther and lose nothing on the way; and when it is considered that nearly all the gas now supplied is used either for mantle-lighting, heating, or motive power, then the unnecessary expense of manufacturing a gas rich in hydrocarbons, which are merely going to drop out before they reach the consumer, will be apparent.

For lighting purposes, at all events where mantles are used, intensity of combustion is the all-important factor. For this reason a gas rich in hydrogen, and with a low percentage of diluents, is necessary; and from this point of view the gas from verticals is almost ideal. A typical analysis of gas made in verticals is—

	Per Cent.
Carbonic acid	1·7
Unsaturated hydrocarbons	3·0
Oxygen	Nil
Methane	26·54
Hydrogen	55·30
Carbon monoxide	10·60
Nitrogen	2·86
	100·00

Such a gas can be produced and sold at a low cost; and as gas has no monopoly nowadays, but has to compete with electricity, suction gas, &c., a cheap gas is absolutely essential, if increased consumption is to be maintained. Like working costs, the cost of erecting a house fitted with horizontals, inclines, or verticals may vary according to circumstances; and as the cost of repairs and renewals must also have an important bearing on the case, it is not so easy to say how verticals will compare in these respects with the older systems—especially as in this country no really large installations have yet been built.

One or two examples, however, may be given: The Dessau setting at Sunderland cost £8150 for the bench complete, including foundations and coal and coke handling plant = £184 per ton of coal carbonized per day. The Glover-West installation at Manchester, including foundations, retort-house and bench, and coal and coke handling machinery, cost £180 per ton per day. Horizontals, including bench, house, and coal and coke handling machinery, cost from £120 to £140 per ton per day. Inclines are more costly to build, and come out at about £150 to £160.

The cost of upkeep of verticals should, on the whole, be quite as low as, if not lower than, that of horizontals or inclines; but it will be some time before this question can be satisfactorily answered.

Looking at the subject then from all points of view, we may undoubtedly say that considerable progress has been made in carbonizing practice in the last few years, and look forward to even greater progress in the years to come.

Discussion.

Mr. R. H. Ginman (Birkenhead) presented some particulars of the Woodall-Duckham installation of vertical retorts now being put down at the Birkenhead Gas-Works, and gave the cost of this and other systems, together with the space to be taken up by the Woodall-Duckham retorts compared with that required for the others. It was hoped with the new plant they would bring down the cost to 7d. per ton of coal handled, in addition, of course, to the other advantages to be obtained from verticals.

Mr. W. L. Heald (Preston) confessed to being one who was not yet convinced from an £ *s. d.* point of view as to the virtue of verticals over horizontals. He suggested that those who had to tackle this question in their own works should look further than the saving of the decimal of a penny per ton in working charges—study carefully the prime cost of the two systems, and also remember that there were a great many men in the profession who had not been carried away by the vertical system. One thing that surprised him was the figures given as to Derby. According to the paper, the drop in candle power was just over 9 per

cent., and it was the same in the calorific value. His own experience was that the calorific value did not drop in the same ratio as the candle power. Another point he disagreed with was that, by doubling the time, they doubled the weight. He would like to meet somebody who had achieved this. At his works they had doubled their time, but did not get double the weight.

Mr. J. TAYLOR (Mossley) said Mr. Fearon's paper recalled one thing to their minds, and that was the unfortunate position Salford was in with regard to the illuminating power of its gas. He would only be labouring the point if he went beyond stating the fact that a low-grade gas was undoubtedly the best for the consumer, and that the consumer was the person to be considered. In the increase of their output of gas per year, the thing to be considered was what was the best for the consumer; and he had no hesitation in saying that gas of 20-candle power was bad for the consumer, because it was almost impossible for so rich a gas to be properly consumed. Most of the complaints about gas smelling arose from imperfect combustion. On the general question, he reminded the meeting of what had been done at Sheffield by Mr. Morrison with horizontals, and said that the figures given by the latter as to cost and results would be hard to surpass by the vertical people. Then, again, they had not had any experience as yet as to wear and tear with vertical retorts, which might have a very important bearing on the question. He gave all credit to those gentlemen who had taken up verticals, and would look forward to the results of their experience.

Mr. J. M'NICHOLL (Warrington) did not think the comparisons which had been made between verticals and horizontals were quite fair—that was, as to results. In most cases the horizontals had been in use for a number of years, while the verticals were, comparatively speaking, quite new. It was his opinion that they had not heard the last word as to horizontals and their possibilities. There was one point he would like to mention under this head. He was quite sure they did not get the full amount of heat out of horizontals.

Mr. H. C. HANDLEY (Rochdale) asked the difference in composition of tar obtained from verticals and from horizontals.

Mr. FEARON said the tar from vertical retorts was thinner and freer from carbon. The difference was considerable—in verticals, 3 or 4 per cent.; and in horizontals, anything from 12 to 20 per cent. With the tar thinner and more fluid, there were, of course, fewer troubles with ascension pipes and blocked mains in the retort-house.

Mr. C. E. TEASDALE (Salford) said there were undoubtedly many advantages with vertical retorts, particularly that of space, which was an important matter in large towns.

Mr. W. W. WOODWARD (Salford), at the invitation of the Chairman, contributed to the discussion. He said that there was one thing that had not been mentioned in the course of the discussion on vertical retorts. It was the question of the nuisance arising from gas-works; and this would become of increasing importance as time went on. There was no doubt that one great point in favour of verticals and continuous carbonization was the absence of the steam, dust, and smoke nuisance. In reference to the remark made by Mr. Taylor, it was true that in Salford they did labour under a great disadvantage by parliamentary restriction as to candle power; but they hoped to be rid of this in a very few months. He did not see why it was impossible not to have continuous carbonization with horizontal retorts, and some of those present might think about it.

Mr. FEARON, in replying, said he could not vouch for the Derby figures he quoted; but he presumed they had been carefully worked out by Mr. Bell. He agreed that they were still without actual information as to the wear and tear of vertical retorts; but they would get that in time.

Proposed Engineers' Club for Manchester.—A movement is on foot for the establishment of an engineers' club in Manchester. It is considered that a membership of 500 would justify the formation of such a club; and if sufficient additional support is forthcoming, a hall for meetings and a library will be included.

London and Southern District Junior Association.—It is announced that the summer meeting of this Association at Margate (which was unavoidably postponed in May) will be held on Saturday, the 29th inst. Ladies are particularly invited; and the Council hope that the members generally will do their best to support the visit. Those intending to be present will choose their own route for reaching Margate. An afternoon visit to the works of the Isle of Thanet Gas Company will be followed by high tea at the Imperial Hotel, on the invitation of the Directors of the Company.

Scottish Junior Gas Association (Western District).—About eighty of the members and friends of the Association sailed from the Broomielaw, Glasgow, by steamer, on Saturday afternoon, for a cruise up the far-famed Kyles of Bute. The weather was of the best, and a most enjoyable time was spent. Tea was served on board, and was much appreciated. This is the first summer outing the Association have had; but it was so successful that the event is likely to become an annual one. The experience gained will help the Committee another year to improve even on last week's efforts, and appeal to an even larger circle of the members. Certainly these outings can serve a very useful purpose, in bringing the members closer together in a social capacity. The arrangements were in the hands of the Secretary, Mr. David Fulton.

AN ABSOLUTE UNIT OF LIGHT.

A paper by Dr. H. Strache, Professor at the Technical High School at Vienna, on "Objective Photometry and an Absolute Unit of Light," has been published in recent numbers of the "Zeitschrift des Vereines der Gas- und Wasserfachmänner in Oesterreich-Ungarn." It will be remembered that the subject was discussed at the last meeting of the International Photometric Commission at Zürich ["JOURNAL," Vol. CXV., p. 355]. The following is an abstract translation of Professor Strache's paper.

The greater number of dimensions and measures employed in science and art are based on the fundamental units of length, weight, and time. The illuminating power of a flame and the intensity of the illumination of a surface are estimated by the eye; and as impressions on our organs of sense cannot be expressed in units of length, weight, and time, they can at best only be compared one with the other. It may be ascertained exactly whether two surfaces are equally brightly illuminated, but it is not possible with the eye to determine whether one surface is twice as brightly illuminated as another. Equality only can be established, and not definite differences in the impression of light on the eye. A second factor still further increases the difficulty. Most sources of light are composed of a great number of different colours. Each colour causes a particular impression on the eye, and it is impossible to say with precision whether two surfaces illuminated by lights of different colours are equally bright. No equality is possible with different colours. Only an estimation of approximate equality can be made. Fine lines, &c., may be imposed on the illuminated surfaces to weaken the illumination until the lines are no longer distinguishable. The illumination with which the lines appear equally strongly on the two illuminated surfaces may be taken to indicate the same illuminating power. All considerations, however, show that photometry, as at present carried out, can never be an exact method of measurement, because it depends on the eye, the observations of which differ with different persons. It would be extremely valuable if photometry could be made independent of the subjective impression of the senses; the present method being replaced by an objective method independent of the personality of the observer.

To take the analogous case of the determination of equality of temperature of two rooms, the subjective personal impression of the temperature has been displaced by the objective measure afforded by the thermometer; but a similar transition is not readily feasible with other impressions of the senses. At present it would not be possible to express the intensity of a smell or flavour by a linear measurement. With the sense of hearing the problem is somewhat simpler, since the energy of the waves which act on the drum of the ear may be otherwise ascertained. With the intensity of light, however, the problem is more difficult, mainly because the action of light on the eye does not correspond with the energy of the light waves. Light of different wave-lengths affects the eye in very different ways and different degrees. Smaller or greater wave-lengths than 0·4 to 0·8 thousandths of a millimetre (0·4 to 0·8 μ) do not affect the eye. Within this range, however, a widely different sensitiveness of the eye for different wave-lengths is observable. The wave-lengths which give the impression of a yellow-green colour act many thousand times more strongly on the eye than does the same amount of energy in dull red light.

The eye is only equally sensitive to the same amount of energy when the waves are of the same length. Physical instruments may be employed to measure the energy of the waves; but in comparing the effect of different wave-lengths on the organs of sense they fail. An objective photometer, independent of the human eye, appears, therefore, to be out of the question when lights of different colours have to be compared. But it will appear later that it is possible to make it independent of the eye of a particular observer. At best, the comparison of the brightness of two surfaces illuminated by lights of different colours can be only an estimation, which must be different with different observers. The use of fine lines, &c., already referred to, does not make the estimations of different observers alike, because one observer's eyes will be more sensitive to yellow light, and another's to blue. Some scientists have endeavoured to ascertain what are the extreme differences in photometric measurements of lights of different colours when carried out by different observers, with the object of finding one observer whose results would represent the mean of all eyes for different colours. This scheme is, however, scarcely practicable.

There are different methods of measuring the energy in light waves; but all the means depend on the light being received on the smoked surface of a sensitive heat-measuring instrument. Black soot absorbs light completely, and is warmed thereby more or less according to the energy of the light waves. Measurement of the temperature of the smoked body converts the light measurement to an absolute measurement of temperature. The instruments used for this measurement, however, measure only the energy of the light waves, which does not correspond with the impression which they make upon the eye—*i.e.*, the light. In order to convert the energy to the light impression, it must be known to what extent the eye is sensitive to the energy in different wave-lengths or different colours. To ascertain this, one

observer may compare photometrically the different colours of the spectrum of a particular source of light, and determine by physical apparatus the distribution of energy in the spectrum. The light produced by unit energy in the yellow-green portion of the spectrum may be taken as unity, and a scale based thereon formed for the light corresponding to the same amounts of energy in other parts of the spectrum. A curve may thus be produced which represents the sensitiveness to light of the observer's eye. Lummer has published such curves for two different observers; and if these observations were extended, mean curves could be drawn which would represent the sensitiveness of the average human eye. The light emanating from a source is decomposed into a spectrum. The portion which has the greatest effect on the eye—*i.e.*, the yellow-green portion—is received unreduced on a radiometer. The other portions, which exercise a smaller effect on the eye, are reduced (by absorption) in proportion to the reduction in their effect on the eye, and are then received on the radiometer. The light thus decomposed and reduced is again united, and the energy is measured by physical means. The apparatus required for this measurement will be referred to later. Professor R. A. Houstoun recently described such a procedure. [See "JOURNAL," Vol. CXV., p. 412.] Thus by the screening or absorption of the rays which have the smaller effect on the eye, it would be possible to construct an objective photometer, the measurements of which would depend on a measurement of energy or heat. It is essential, however, that it should be known to what extent the eye is sensitive to waves of different lengths.

The author proposed at the last meeting of the International Photometric Commission at Zürich that a Sub-Committee should be formed in order to investigate this question [See "JOURNAL" Vol. CXV., p. 357]. If a process such as that described were once carried out, an absolute unit of light could be established without any difficulty. Differences due to differences in the eyes of different observers would not cause deviations greater than the deviations of different observers according to the present methods of photometry; and the mean differences would be only about half as great as at present. The first point was to establish the curve of sensitiveness to light of the eye for as many observers as possible. The distribution of energy in the spectrum of an absolutely black body might be taken as known from Planck's Law, and the distribution of light in the spectrum determined for a particular temperature, in order to ascertain from the separate values the ratio of the energy to the light effect of the different waves. The distribution of light might be determined by the aid of a spectro-photometer of suitable construction, as had been done by Lummer. Brodhun has objected to this method on the ground that the constants of the absolutely black body cannot yet be determined with sufficient certainty. Another method consists in determining the distribution of light as well as the distribution of energy in the spectrum of any constant source of light. As the determination of the distribution of the energy is not readily made, it would be desirable to determine it exactly for one source of light—such as the Hefner lamp—and then to determine the distribution of light in that source with as many observers in as many places as possible. Against this it may be said that the intensity of the Hefner light is so feeble that it will be difficult to determine the distribution of its energy in the spectrum. But the method should be kept in mind, in case it may ever be possible to construct an instrument which will measure, with sufficient exactness, the small energy of the Hefner lamp in the different portions of the spectrum. On the other hand the 10-candle pentane lamp with its greater intensity might be used in place of the Hefner lamp. A third method would be to make a measurement of the radiation through the whole spectrum in conjunction with a determination of the distribution of light by one or more observers. This method, though more complex, avoids dependence on the Hefner lamp or similar source of light. While the measurements are being made, however, the constancy of the light in respect of radiation and distribution of light must be ensured. The distribution of energy would, however, have to be measured; and this could only be practically carried out if a simpler form of radiometer were constructed.

Reviewing the three methods, the first depends on the constants of an absolutely black body. They are under investigation by the Reichsanstalt at Charlottenburg. But some time must elapse before they are known with sufficient exactness; and on this account the method proposed by the author at Zürich is not immediately applicable. The second method necessitates the distribution of energy in the spectrum of the Hefner lamp being known with precision. For this purpose, either an extremely sensitive radiometer would be necessary, or the radiation of the lamp must be increased by the use of lenses. The latter would be the simpler way. Owing to the small intensity of the Hefner lamp, however, the Purkinje phenomenon would have considerable effect. With relatively small intensities, the green and blue rays act much more strongly on the eye than with more intense lighting. Thus in determining the distribution of light in the spectrum of the Hefner lamp, much greater values would be obtained in the green and blue than with more intense lighting. It would be necessary to ascertain exactly the effect of the Purkinje phenomenon on the apparent distribution of light in the spectrum. In order to avoid its effect, the rays might be concentrated on the photometer disc. The third method is applicable to lights of any intensity. For instance, an electric incandescent lamp with a straight filament may be used, supplied with constant current. The current need only remain constant until the distribution of energy and the distribution of light in the spectrum have been ascertained. Such a lamp has the advantage that the straight filament can be regarded as a luminous line, and takes the place of the slit of the spectro-photometer. Thus a very well-lighted spectrum is obtained, and the measurement can be made exactly with relatively simple means. A simple radiometer is, however, requisite for this method, and hitherto such an instrument has not been obtainable.

The author proceeds to mention the apparatus required for carrying out the measurements referred to. For obtaining the curves of the distribution of light, a spectro-photometer is necessary. Hitherto this instrument has been chiefly used for comparing photometrically the same colours of the spectra of two lights. One designed by Thovert was shown by M. Vautier at the last meeting of the International Photometric Commission at Zürich. [See "JOURNAL," Vol. CXV., p. 359.] It is readily manipulated, and may be used on any photometer bar. But for the present purpose a spectro-photometer is required with which the brightness of different colours of two sources of light or of a single light may be compared. Hirschberg's double spectroscope would admit of this; but Krüss has pointed out that unfortunately the colours on the two sides of the observation slit are reversed. The same thing occurs with Helmholtz's colour-mixing apparatus. The Lummer-Pringsheim spectral photometer consists of two parallel slits in the collimator tube illuminated by the same light. The images of these slits in the spectra partly coincide. In the place of the eye-piece slit, the field appears to be lighted from one slit in a different colour than from the other slit; and if the two slits are alternately darkened, the two colours of the same light appear alternately in the eye-piece. By altering the width of the slit, the illumination of the two fields of the spectra can be made equal, so that no flickering occurs. This spectro-photometer is, however, only suitable for comparing two adjacent colours of the spectrum; and thus the colours must be dealt with step by step throughout the spectrum. Krüss, at the author's suggestion, has constructed a spectro-photometer, which will be more fully described in a subsequent paper, by which any portions of the spectrum of two different lights or of the same light, may be compared photometrically, and which can be used on a photometer bar so that the spectro-photometric measurement may be carried out like an ordinary photometric test. The instrument is designed so that either of the two adjacent fields of vision are lighted partly with one and partly with the other colour, and that the same illumination of the two fields of different colours may be obtained. Or by simple reversal, the images of the two slits are superimposed, and a flicker device, by which the images are covered in turn, renders it possible to obtain in the same portion of the field of vision alternately one or the other colour of the spectrum. The disappearance of the flickering admits of closer observations being obtained than in the ordinary comparison of colours.

M. Thovert has quite recently utilized sharpness of vision for measuring the sensitiveness to light of the eye for different fields of the spectrum. He puts signs and letters before the eye-piece of a spectroscope, and ascertains for any distance of the source of light the part of the spectrum where the signs can just be distinguished. He has made measurements in this way of the Carcel lamp, incandescent gas light, and sunlight. The maximum sensitiveness according to his measurements with the Carcel lamp is at $0{\cdot}58\mu$, with the incandescent light $0{\cdot}57\mu$, and with sunlight $0{\cdot}562\mu$. He has also taken the results of other observers, which show for sunlight that the maximum sensitiveness lies between $0{\cdot}52$ and $0{\cdot}568\mu$. Abney has drawn a curve for the mean of previous results, which shows that the maximum sensitiveness lies at the wave-length $0{\cdot}566\mu$. Thovert points out that the different curves agree tolerably well, but that the position of the maximum of sensitiveness has very great influence with different observers. Thovert's curves only express the sharpness of vision with light of different colours, and do not depend on the curves for the distribution of energy. Nevertheless, his curves broadly have the same form as the curves which express the sensitiveness to light in terms of the energy applied.

For measuring the distribution of energy in the spectrum, the same radiometer which is used for the measurement of the dark heat rays is employed; but as only the light rays are in question, the precautions necessary for the measurement of heat radiation, depending on its ready absorptivity, are not necessary. Ordinary glass lenses and prisms may be used, provided the comparatively small coefficient of absorption of the glass for rays of light is taken into account. It is thus possible to concentrate the rays of light on one point which may be the most sensitive part of the radiometer. The similar concentration of heat rays is not possible owing to their absorption by glass; and therefore a considerably higher efficiency may be obtained in the measurement of light rays by the radiometer. Radiometers depend on the absorption of the rays by a smoked surface and the measurement of the rise of temperature of the surface. As the quantities of heat are extremely small, the most sensitive portion of the radiometer must have an extremely small capacity for heat, so that the increase in its temperature may be measurable. Therefore, there are used for this portion either extremely thin metal strips or else flattened wires, the increase of temperature of which is measured by the determination of the electric resistance (by the so-called bolometer), or of a great number of thermopiles in series consisting of leaves of two different metals soldered to one another.

Rubens' thermopile, which is of the latter type, has been recently made considerably more sensitive by Johansen.

These, which are the commonest radiometers, require that an electric current should be exactly measured by aid of a sensitive mirror galvanometer. Hence the measurements are by no means simple. The author has endeavoured to construct a radiometer which is of a simple type, and he has given it the name "microthermoscope." It will be described in a subsequent paper. It admits of increases of temperature of one ten-thousandth of a degree Centigrade being measured. It is, therefore, now possible by one or other of the ways mentioned, and with the use of any one of the spectro-photometers and radiometers described, to determine the curve of sensitiveness to light of the eye for a large number of observers. Having deduced therefrom a mean curve for a standard eye, a photometer can then be constructed which decomposes the radiation of the source of light into a spectrum and, by insertion of a diaphragm or absorptive medium, weakens each wave-length until it corresponds to the sensitiveness to light of the eye. Afterwards the rays are brought together on to a radiometer. Such an instrument would admit of the illuminating power or intensity of a light being measured without the use of the eye or a standard of light. The result could be converted to the heat units which emanate from the light and affect the eye as light. Thus the illuminating power would be expressed merely in heat units, and a new absolute unit of light would likewise be represented by so many heat units. This does not imply that the present units of light—such as the Hefner, the Carcel, and the Harcourt lamp—would be entirely dispensed with; but these units would be capable of being referred to a definite absolute unit or absolute measure. Professor Houstoun described a short time ago how it would be possible to measure light according to absolute measures with the help of a thermocouple. He placed a light filter between the light to be measured and the thermocouple. This filter completely removed the ultra-red and ultra-violet rays and absorbed the energy of the rays of the visible spectrum in inverse proportion to their light-producing effect. From a series of investigations on the "Absorption of Light by Aqueous Solutions of Inorganic Salts," Houstoun finally adopted a filter consisting of layers of definite thickness containing solutions of copper sulphate and potassium bichromate of definite strength. The absorption curve obtained by means of this filter agrees with the curve for the sensitiveness to light of the eye found by Professor A. König and Mr. P. G. Nutting. This applies to a particular illumination of the field, and with other degrees of illumination the concentration of the solutions would have to be altered. The light lost by reflection at the glass surfaces and by absorption in the glass is determined by a spectro-photometer, and corrections applied therefor. In this way, Houstoun showed that the galvanometer readings can be made proportional to the illuminating power of the source of light. He then proposed a definition for an absolute unit of light involving the use of screens containing aqueous solutions of salts. [See "JOURNAL, Vol. CXV., p. 412.]

Further consideration should be given to the question of whether it is desirable to introduce into the definition of the absolute unit of light any chemical substances at all. It would be better if it were possible to define the absolute unit of light only in terms of the units of length, weight, and time, without requiring that any particular substance should be employed for the measurement. The author has endeavoured to show in the foregoing that this is possible. If Houstoun's method of objective photometry should prove better adapted for practical use than the instrument referred to by the author, it would be possible to convert results obtained by Houstoun's method into terms of an absolute unit of light based on the measures of length, weight, and time.

A Sub-Committee was appointed, on the proposal of the author, at the last meeting of the International Photometric Commission at Zürich, with instructions to report to the Commission whether it appeared possible, having regard to the work on the sensitiveness of the eye for different wave-lengths, to establish a unit of light based on absolute measures, and what steps should be taken to solve the problem. It appears to the author that the points which have to be dealt with are as follows:

(1) Testing different spectro-photometers in respect of their applicability for the purpose.

(2) Testing different radiometers in respect of their applicability for the purpose.

(3) Finding the distribution of light in the spectrum of an absolutely black body.

(4) Finding the distribution of light in the spectrum of the Hefner, Harcourt, and Carcel lamps, and Violle's platinum unit of light.

(5) A study of the effect of Purkinje's phenomenon on different eyes.

(6) The exact determination of the constants of an absolutely black body.

(7) The determination of the distribution of energy in the spectrum of the Hefner, Harcourt, and Carcel lamps, and of the Violle platinum unit of light.

(8) A summary of the results obtained by different methods of determining the curves for the sensitiveness to light of the eye.

(9) Producing a curve representing the sensitiveness for the normal eye and the extent of the deviations found for different eyes.

(10) Specifications for making an objective photometer.

(11) Specifications for the definition of an absolute unit of light and discussion of Houstoun's specification.

SCOTTISH JUNIOR GAS ASSOCIATION.

(EASTERN DISTRICT.)

Visit to Milton House Works.

In connection with the Eastern District of the Scottish Junior Gas Association, a visit took place on Saturday to the premises of Messrs. James Milne and Son, Limited, Milton House Works, Edinburgh. There was a company numbering some sixty, and the outing was one of the most valuable, from the educational point of view, that has been held within recent date by the members. The firm occupy a unique position, and their connection with gas lighting may be said to be a natural development of the earlier activities of the founders of the business. The originator of the firm was John Milne, regarding whom there are authentic records as a bell-founder and ironmonger in High Street or Castle Hill, Edinburgh, as far back as 1750. But bells with the name of Milne on them have been found in Scotland bearing an earlier date. The present members of the Milne family are of the sixth generation in descent from John Milne. In the early part of last century, James Milne, son of John Milne, took advantage of Murdoch's achievements in gas lighting, and from the manufacture of oil-lamps, to fittings suitable for the new illuminant James Milne turned his attention and energies, and thus became one of the pioneers of gas lighting in Scotland. The small and somewhat primitive gas-works of James Milne provided for the lighting in a highly satisfactory manner of three of the largest of the Edinburgh shops, and the success of the experiment led to the formation of the Edinburgh Gas Company, from which humble origin sprang the Edinburgh and Leith Corporations' Gas Commissioners. Sir Walter Scott was connected with the Edinburgh Gas Company, and for a time was Chairman of the undertaking. The development of the gas undertaking was coincident with the progress of the firm; and from practically the centre of Old Edinburgh, the works were in 1852 transferred to Milton House, in the Canongate, where for nearly thirty years they were situated. A removal was effected to the present site, and the name Milton House transferred with them.

The company was split up into small groups, and under the direction of Mr. F. K. L. Goad (the General Manager), Mr. R. Graham (Engineer's Department), and Mr. Richard Milne, the visitors were conducted through the various departments. The brass foundry and pattern-shop were first inspected, and the different varieties of fittings in their several stages of construction were examined with much interest. Adjoining was the components' shop, in which are manufactured the prepayment attachments for gas-meters, and small meter parts. An automatic machine for making meter-couplings, &c., was a keen attraction. From the stamping-shop to the meter-store was only a step; and here the visitors got first-hand information as to the different parts of gas-meters and their fittings. The proving-shop was seen, and also the compressor-house, where there are installed two belt-driven compressors. One of the compressors supplies gas for industrial purposes, and the other does the same for lighting. High-pressure gas is used throughout the works as the illuminant. Compressors were seen in various stages of manufacture—some of the finished stock being destined for New Zealand. In the erecting-shop a 60,000 cubic feet rectangular station meter (to be erected at Winnipeg) was the object of scrutiny; and it was explained that a slightly smaller station-meter was in course of construction for Toronto. The firm have other activities besides gas; but it was the gas sections of the business that came in for the attention of the members of the Association, and in this direction the facilities afforded for the inspection of the different parts, the tools used in their manufacture, the patterns, and the various machines were of the freest kind.

Subsequently the visitors were entertained at tea at Messrs. Fergusson and Forrester's, in Princes Street. The chair was occupied by Mr. Adam Macpherson, one of the Directors, and the members of the Milne family present were Mr. John and Mr. Richard. There were also present Mr. Goad, Mr. Graham, Mr. Thos. Fox (Manager of the Meter Department), and Mr. Henry O'Connor, who for a long term of years was connected with the establishment. Mr. John R. Moyes, the President, asked the members to accord a hearty vote of thanks to the firm, for the manner in which they had been received at the works. The visit had been, he said, an education to them. Mr. Adam Macpherson replied on behalf of the firm, and said it was a pleasure to learn that they had been satisfied with their visit to the works. That day the works had been freely opened to them; and personally he would never forget when, as a young man of 23, he took up the position of Gas Manager at Kirkcaldy, the visit he paid to Milton House Works. Mr. Milne, the grandfather of the present members of the family in the firm, was his guide on that occasion, and his welcome was a most cordial one. He was very pleased to be there that day, as he was, he supposed, about the oldest member of the North British Association of Gas Managers. Mr. A. Strathearn (the Commercial Manager) also replied, and referred more particularly to the educational value of such visits to the members of the Association.

Mr. Henry O'Connor also made a few observations, more particularly relating to the education side of the outing. He referred to some remarks made by Mr. A. F. Browne, of London, in which he advised students that, for the complex work of gas engineering, something more than mere attendance at technical lectures was

requisite. He emphasized the great value to the members of the Association of the different visits which they paid to gas-works and establishments connected with gas manufacture. Mr. W. Geddes, in a few sentences, spoke of the educational work of the Eastern Section of the Scottish Junior Gas Association.

At the call of Mr. Richard Milne, a vote of thanks was accorded to the Chairman for presiding, and was acknowledged by Mr. Macintosh; and the company thereafter separated.

The next meeting of the Association will be on July 6, in the Heriot-Watt College, when the proceedings for the session will be brought to a close.

STANDARDIZING CONDITIONS OF CONTRACTS.

Proposed Adoption of Standard Clauses by the Institution of Water Engineers.

At the recent annual meeting of the Institution of Water Engineers, Mr. HAROLD W. WOODALL, M.Inst.C.E., the Engineer and General Manager of the Bournemouth Gas and Water Company, introduced for discussion the subject of the desirability of standardizing the general conditions of contracts.

Mr. WOODALL said the advantages of having standard clauses of contract when asking for tenders for the construction of engineering works would appear to be many. In the first place, it saved the engineer a considerable amount of trouble to have standard clauses, admittedly equitable to both parties, which he could incorporate as a whole, instead of having to consider and draft them for each specification he sent out. In the second place, both engineer and contractor knew exactly how they stood in relation to the contract; no arrangements having to be made as to the interpretation of clauses or the modification of those which the contractor might think unreasonable or capable of misinterpretation. Competition was so keen nowadays, and tenders were cut so fine, that it was more than ever essential that contractors should not only tender to the same specification, but that they should all interpret it in the same way. When one introduced various fancy clauses, there was a chance of something being omitted, and the engineer saying at the end of the contract that it was included under a certain clause. The contractor would reply that he did not interpret it so; and litigation usually followed, and the throwing away of money which should have been spent in useful, productive work. He did not claim that such troubles would be entirely removed by the adoption of standard clauses, but they would certainly be mitigated; and one of the results of their adoption would be to establish eventually standard legal rulings. No work could be satisfactory unless it was carried out in good faith and good fellowship by the various contracting parties. The employer wanted certain work done to suit the purpose of his business; and he was usually prepared to pay a fair price to get it. The engineer wished to secure for the employer the most suitable design or the most suitable materials at the lowest price consistent with the contractor securing a reasonable profit. The contractor, if only for the credit of his firm, wished to carry his contract to a successful conclusion; and so far as his (Mr. Woodall's) experience of established English firms was concerned, he was usually willing to accept a very reasonable margin of profit. Given an honourable employer, a just engineer, and an honest contractor, the interests of all parties concerned became practically identical, as they were all anxious to bring the contemplated work to a satisfactory conclusion at the lowest reasonable cost. He was inclined to think that a distrustful attitude, and a harsh, overbearing specification, frequently counteracted the intention with which it was framed, and resulted in a considerably higher quotation from the contractor and consequent loss to his employer. For the foregoing reasons, he thought that, when the introduction of standard clauses was contemplated, they should be drawn up by a committee of engineers, and submitted for the consideration of a committee of contractors before being finally adopted. With a view to securing fair and satisfactory clauses in contracts, the Institution of Gas Engineers and the Society of British Gas Industries each recently appointed a Committee to meet and draft standard clauses. In the result, some were drafted which, in his opinion, were worthy of general adoption. Very careful consideration was given to the responsibilities of the various parties to the contract, and to the questions of penalties, payment, and arbitration, as it was felt that these had been in the past a fruitful source of friction and expense which were both unnecessary and contrary to the interests of all parties. He had used the clauses referred to for two large contracts, and they appeared to be clear, simple, and satisfactory to all concerned. They were equally applicable to the work of water engineers; and he suggested that they would form a useful guide. If the members felt that this matter was worthy of consideration, they would find a useful foundation for their labours in the work already accomplished by the kindred Institution.

Discussion.

Mr. W. MATTHEWS (London) said he was in accord with what Mr. Woodall had said. Personally he had found uniform general conditions of contract very useful. He had with him a set which he had used with very little alteration for twenty-five years. In no case had they led to litigation, and from this he could only assume that contractors looked upon them as reasonable. As to the question of standard specifications, he had arrived at the conclusion that when they came to descriptions of work and materials, these specifications were impossible. One was astonished, on going into it, to find how almost out of the question it was to use the same clauses in any two contracts; and he thought it would be a pity to attempt anything of the kind. To the extent he had indicated, however, he was in accord with Mr. Woodall; and he suggested that the matter should be considered by a Sub-Committee. They must remember that if they wanted to get these standard conditions loyally and heartily carried out, they must secure the approval of the contractors as a body. The main thing was to look after the interests of their clients; and unless they had the contractors with them to the extent that they were satisfied they were being fairly and honourably dealt with, there was sure to be friction.

Mr. H. ASHTON HILL (Birmingham) said he had received the general conditions of the Institution of Gas Engineers, and on looking through them he found that the clauses were, in the main, those which he had been using for many years. He agreed with both Mr. Woodall and Mr. Matthews, inasmuch as he thought the question to be worthy of consideration. They should try to standardize as much as possible; but he thought there was a difficulty in the way. When the Institution of Gas Engineers and the Society of British Gas Industries got together, they were, no doubt, thinking of ironwork and apparatus, which would loom larger in their business than building. There was a difference between the conditions affecting building contracts and those in machinery contracts. Then it was possible to have too elaborate specifications, which were apt to lead to more expensive jobs. However, the subject was of great interest to them all, and was worthy of consideration. Of course, if they had standard clauses, it was not necessary to put them into every contract.

Mr. C. H. PRIESTLEY (Cardiff) approved of Mr. Woodall's proposals, but said there were several difficulties to be considered, especially in connection with what Mr. Hill had mentioned. Specifications for engine-houses and pumps were very different from what would be required for large storage reservoirs; and the conditions could not be made analogous in the two cases.

Mr. A. VALON (London) said he did not quite agree that it was impossible to frame conditions of contract which would be equally applicable to all kinds of work. He had for a good many years used certain definite conditions of contract, and he found that they applied quite well all round. Occasionally some modification was necessary; but it was usually very small. The advantage of having standard conditions was that the contractor knew what he was called upon to do, and the engineer knew what he could call upon the contractor to do. He agreed with Mr. Woodall that more difficulties arose owing to misconceptions on the part of contractors as to the conditions under which they worked than from any other cause. One did at times have difficulties, and wanted as tight a specification as one could really get; but if the engineer made the conditions of the contract too tight, the contractor would put on extras sufficient to cover himself, unless he was a man who did not care, and simply went in on the chance of getting through. This, of course, was the sort of man they wanted to keep out.

Mr. H. C. HEAD (Winchester) remarked that lawyers fully appreciated the value of standardizing. In the district he came from, all property sales were conducted subject to the conditions drawn up by the Hampshire Law Society; and this was found greatly to facilitate business.

The PRESIDENT (Mr. J. S. Pickering) said the Council of the Institution would be very glad to take this matter into consideration. Personally, he felt it was desirable that there should be a standard set of conditions applicable to water engineering, if they could be drawn up and could meet with the approval of all concerned. It was interesting to hear that Mr. Matthews and others had had conditions in use under which no difficulties were experienced. They might not apply to all cases; but they could have them as guides. It was desirable that there should be a mutual standard, for one reason in particular. If any legal controversy occurred, the decision on the standard clause would be known to all, and the clause could be altered if necessary to meet any objections that might be raised. He would take it that the feeling of the meeting on the matter was that the Council should take it into consideration, and bring up a report upon it, together, possibly, with a set of conditions for the approval of members.

The meeting unanimously approved of the course suggested.

Among the awards made by the Council of the Society of Arts for papers read in the past session is a silver medal to Mr. H. A. Roberts, M.A., for his communication on "Education in Science as a Preparation for Industrial Work," which was noticed in the "JOURNAL" for the 5th of March last (p. 647).

Readers will have seen from the daily papers that arrangements are in progress for the fusion of the central offices of the Conservative and Liberal Unionist sections of the Unionist Party. In connection with this, it is officially announced that Mr. John Boraston has been appointed Principal Agent of the party, and will shortly take up the duties of the office. Mr. Boraston, who is a Solicitor by profession, is one of the Directors of the South Suburban Gas Company; and he has for many years taken a keen interest in politics. It is unfortunate that at this juncture he should have had to undergo a serious operation; but, according to the last reports, he is making satisfactory progress.

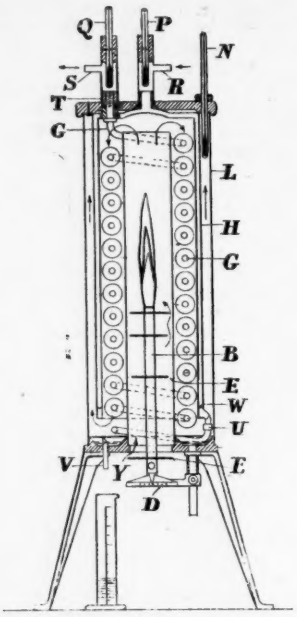
REGISTER OF PATENTS.

Calorimeters.

MACKLOW-SMITH, A., of Queen Anne's Chambers, Westminster, and PULLEN, W. W. F., of Heaton Moor, near Stockport.

No. 19,051; Aug. 25, 1911.

This calorimeter is provided (1) with means by which the radiation of heat to or from the atmosphere is reduced to a minimum; (2) with means for churning or mixing the water just before it leaves the apparatus, so as to prevent vibration or jumping of the mercury or other thread in the outlet thermometer; (3) with means whereby the flow of water through an annular space to a coil is rendered uniform; (4) with means whereby all the condensation water in the combustion products is trapped and measured; (5) with means for adjusting the admission of air to support combustion; (6) with parts readily assembled and disassembled to facilitate inspection and cleaning.



Macklow-Smith and Pullen's Gas-Calorimeter.

In the vertical section given of the calorimeter, the burner B is supported by an arm on a pillar attached to the base; and its position may be adjusted by a thumb-screw so as to regulate the amount of air passing to the burner for combustion. To ensure the same height of burner on different occasions, a distance-piece is inserted between the arm and the base of the instrument. Baffles or collars E are fixed upon the burner to intercept rays of heat which pass downwards from the flame, some of which will be reflected from the inside surface of the chimney. In this manner, radiation from the flame down the chimney will be minimized. The air to support combustion, other than that which may reach the burner, passes through the opening Y, between the lowest baffle and the base, and then up the chimney—cooling the collars upon the burner together with the lower end of the chimney. The amount of air admitted is regulated by the opening at Y. The chimney is surrounded with a helical tube G, "which may be gilled or braided or otherwise have its heat-absorbing surface increased by having super-posed upon it ribbon or sheet metal in direct metallic contact with it."

The coil is connected to an annular vessel H at its lower extremity; and at its upper extremity it passes through the annular vessel – a tight joint being made by the nut T, which also contains an outlet nipple S and a thermometer Q for the measurement of the outlet temperature of the water passing through the coil, and which water absorbs the heat produced by the combustion of the fuel. "By compelling the cooling water to pass through the coil just prior to its egress from the instrument, the churning of the water which is produced by its passage through the coil thoroughly mixes it and prevents the outlet thermometer thread from jumping or vibrating due to irregularity in the outlet temperature of the water."

To permit of the coil being withdrawn for inspection or cleaning, a joint is made at U. The upper end of the vessel H is connected to a fitting containing the inlet nipple R, and a thermometer P for measuring the temperature of the water as it enters the instrument. The arrows at R and S denote the direction of the current of water; the remaining arrows, the path of the products of combustion.

The top of the annular vessel is extended beyond the cylindrical portion and is attached to the cover, which rests upon the outer shell L. Through the space between the outer shell and the annular vessel H, the products of combustion rise and pass out into the atmosphere through holes in the cover or through holes near the top of the outer shell; the temperature of the products of combustion being indicated by the thermometer N.

The water produced by combustion gravitates to the circular trough in the base of the instrument, and descends into the measuring vessel through the tube V. As the chimney is interposed between the hot products of combustion and the coil G, the water of combustion will not condense on the inside surface of the chimney next to the flame and run down without being measured, but will be wholly condensed in the space between the chimney and the annular vessel H—"thus facilitating a very accurate determination of the 'lower' calorific value of the fuel." The length of the flame may be adjusted by a regulator D, at the foot of the burner.

An annular diaphragm W, pierced with a series of holes, is situated near the lower end of the vessel H. The holes are varied in size; the smaller ones being nearer to the joint U than the larger ones, so as more nearly to equalize the flow of water from all parts of the annular vessel to the coil.

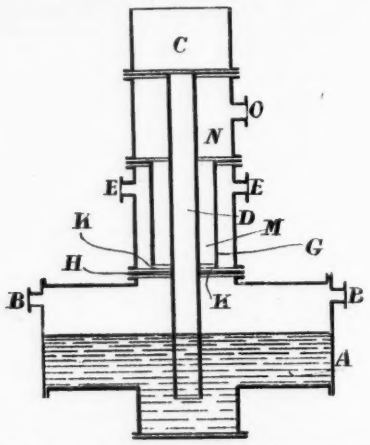
The construction described permits of the calorimeter being rapidly taken to pieces. Thus, by lifting the cover, the coil and annular vessel may be withdrawn; and then the outer shell L and the chimney may be separated from the base. Then the coil may be disconnected from the annular vessel at U and T.

Production of Sulphurous Acid from Sulphur.

FELD, W., of Linz-on-Rhine, Germany.

No. 21,996; Oct. 5, 1911.

The object of this invention is to obtain, by the combustion of sulphur, sulphurous acid practically free from sublimated sulphur without the use of sublimators or condenser-like arrangements. The patentee prefers to employ apparatus in which the heat of the combustion of the sulphur vapour is employed to pre-heat the air to support combustion and to melt the fresh sulphur.



Feld's Apparatus for Producing Sulphurous Acid.

In the vertical section shown, A represents the sublimating furnace, in which the melted sulphur is partially burned and partially sublimated by air which enters at B. C is the charging hopper for charging fresh sulphur. D is a pipe which leads from the charging hopper to the furnace and dips into the melted sulphur in it. E are pipes for the supply of air to support combustion of the sublimated sulphur. This secondary supply of air flows round the pipe G, which is flanged to close in the air-supply shaft at the top—its inner walls constituting the combustion chamber M. The secondary supply of air which descends outside the pipe G is preheated by contact therewith; and, at the lower open end of the pipe, it strikes against the horizontal annular plate H, which has a concentric opening in the middle. The preheated secondary supply of air passes through the space K between the lower end of the pipe G and the inner edge of the plate H. The preheated air issuing from the space K comes in contact with the ascending sulphur vapour, and burns it in the combustion chamber M. This chamber is formed by the space between the inner wall of the pipe G and the outer side of the pipe D, and (as described) a portion of the heat of combustion is imparted to the air flowing down outside the pipe. The gases of combustion collect in the chamber N, which is closed in at the top by the bottom of the sulphur-charging chamber C. The products of combustion escape through the outlet at O. Thus part of the heat of combustion melts the fresh sulphur entering by the pipe D.

Extracting Nitrogen and Carbonic Acid from Combustion Gases.

BRAUN, H., of Berlin.

No. 22,531; Oct. 12, 1911.

The specification of this invention states that there are already known methods of obtaining nitrogen and carbonic acid from products of combustion; the gases being "passed over metal or metallic oxide or over a mixture of metal and metallic oxide, the metal serving for binding the oxygen and the metallic oxide for burning the unburnt constituents."

The present invention relates to apparatus for carrying out the process described in patent No. 20,631 of 1909. The products of combustion, which may possibly contain a large excess of free oxygen and only a small quantity of unburnt combustible constituents, are mixed with such a quantity of combustible gases that the free oxygen and the unburnt combustible constituents are in approximately equivalent proportion for perfect combustion. The gases are then brought into contact with copper oxide heated to a suitable temperature, when the unburnt combustible constituents and the free oxygen combine, forming carbon dioxide and water or steam. The combustible gases may be generator gas, water gas, vapours of naphtha, petroleum, mineral oil, sperm oil, or the like. After condensation of the steam, the gases consist of a mixture of nitrogen and carbon dioxide, which can be separated by known methods. If the gases passing over the copper

oxide contain an excess of the combustible constituents, the copper oxide will be gradually reduced to copper. In order to avoid a complete transformation of the copper oxide into copper, the patentee points out that care should be taken to increase the percentage of the oxygen in the mixture, whereby the initial condition is restored.

Treating Porous Refractory Materials so as to Render them Gas-Tight.

LESSING, R., of High Holborn, W.C.

No. 12,119; May 19, 1911.

The primary object of this invention is to render the walls of gas-retorts, coke-ovens, &c., gas-tight, by "forcing hydrocarbon gas or vapour from one side of the material into the pores and other openings which may exist in the mass of the material, and in heating the mass from the opposite side, so that the gas is dissociated and carbon deposited in the pores, thereby rendering the material gas-tight, and (in the case of a gas-retort) preventing loss by leakage through the walls of the retort of the gaseous products of distillation, and at the same time preventing such products becoming deteriorated by infiltration of the heating gases through the walls into the interior of the retort."

In the case of a gas-retort, the patentee says, the deposition of carbon in the pores would most conveniently be effected after the retort is in position—the gas being generated in the usual way on the first charge of the retort. The gas uptake would be closed so that the gaseous products of distillation were forced through the pores of the retort walls until, becoming dissociated by the high temperature to which the retort is raised by the heating gases, carbon is deposited within the pores, and the process is continued "until the walls become substantially impervious to gases."

In lieu of producing the gas from the first charge of coal, it may be introduced into the closed retort, under pressure in gaseous form, or a liquid hydrocarbon may be so introduced and the gas generated by heating. The temperature to which the retort is raised and the pressure within it are regulated so as to insure the substantially complete closing of the pores of the material by the deposit of carbon within the pores, with the result that not only is it rendered impervious to gas, but it is rendered considerably more refractory.

It may be arranged to introduce a quantity of air or oxygen into the pores of the material—sufficient to obtain partial combustion of the hydrocarbon gas and so cause the deposition of carbon in the pores. This may be done in the case of a gas-retort by having any desired excess of air in the heating gases and by suitably regulating the pressures inside and outside the retort.

When the invention is applied to porous fire-brick or material which is not of a form that can conveniently be made to enclose a chamber for the production or introduction of the hydrocarbon gas, the mass may be placed in, or form one wall of, a chamber into which hydrocarbon gas can be forced under pressure; one or more sides of the block being exposed to the action of heat, so that its temperature may be raised throughout its mass to that necessary for the dissociation of the hydrocarbon gas. Or the block may be bored or cored out to enable the hydrocarbon gas or vapour to be forced through the material from the inside.

Concluding his specification, the patentee says: "The essential feature of the method which constitutes the present invention is that the hydrocarbon gas should penetrate the wall of the retort or the like from one side thereof, while the heat penetrates from the other side; so that deposition of carbon should begin towards the outer or heated side of the material and continue towards the inner side—thereby rendering the wall of the retort or the other material subjected to the treatment impervious to gases, not by forming a lining or coating on one surface, but by filling up the pores and other openings which may exist in the mass of the material with carbon deposited from the hydrocarbon gas forced into the pores by the application of suitable pressure."

Gas-Tight Coal-Valves.

GLOVER, S., of St. Helens, and WEST, J., of Southport.

No. 23,748; Oct. 26, 1911.

This invention relates to a gas-tight coal-valve used in connection with vertical gas-retorts and producers—to ensure easy working and when closed be gas-tight, and also to provide ready means for adjusting the valve to compensate for wear.

The valve consists of a segment of a circle working over a segmental port in the lower side of a cylindrical casing, into which the coal is fed through a tube that enters the body of the valve, and is extended to a point close to the port, and has the side of the tube on the closing side of the value shortened to prevent jamming of the coal. The body of the valve is of cylindrical form, and the valve itself has two discs with a distance-plate forming the surface of the valve which makes a gas-tight joint when in contact with the face of the body of the valve. The coal is fed to the valve through a tube which enters the body of the valve and is extended to a point close to the valve except on one side, which is shortened for the purpose of preventing the coal being

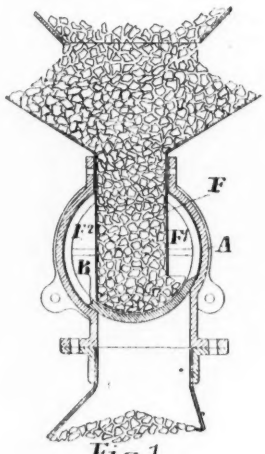


Fig. 1.

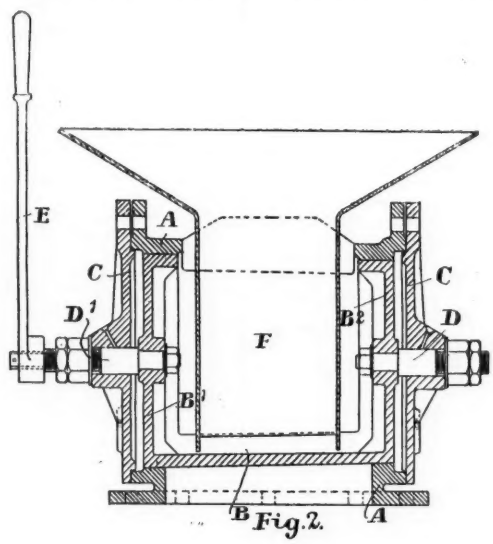


Fig. 2.

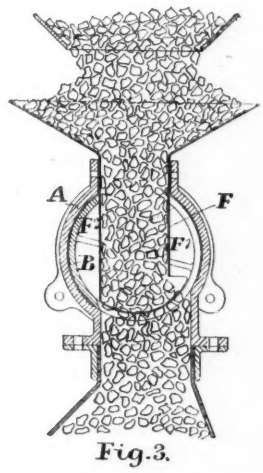


Fig. 3.

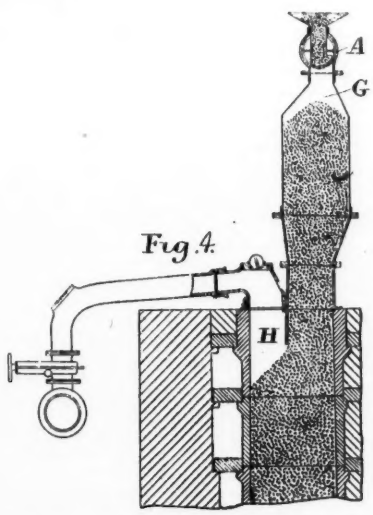


Fig. 4.

Glover and West's Gas-Tight Coal-Valve.

trapped between the valve and its seat when being closed. The valve is pivoted on trunnion centres, and is operated by a lever fixed at one end. The valve is made slightly taper to enable a tight joint to be made between it and the body of the valve—the necessary degree of tightness to prevent the escape of gas or the ingress of air being obtained by adjusting nuts on the trunnions.

Fig. 1 is a transverse section of the valve closed. Fig. 2 is a longitudinal section of the valve. Fig. 3 is a transverse section of the valve open. Fig. 4 is the application of the valve to a vertical retort.

A is the body of the valve; and B, the valve with end discs B^1 B^2, which are connected and form the valve B. C are the end covers of the valve body which carry trunnions D D^1—the latter provided with a lever E, which enables the valve to be rotated on its seat in the valve body. F is a rectangular tube, which may be an extension of the coal-hopper above or supported from the hopper (as shown). Three sides of the tube are extended to close proximity of the valve B; but the remaining side is shorter, so that when the valve B is being closed and its closing edge is passing through the coal there will be no obstruction to trap the coal between the closing edge of the valve and the side of the tube. The coal in front of the closing edge is carried forward into the space F^1; and when the valve is re-opened, the valve passes into the space F^2, which is always kept free from coal by the extended side of the tube F. It is thus possible to open and close the valve with a minimum of exertion, as there is no cutting through the coal or jamming, as with ordinary slide-door valves. When fully opened, the valve is prevented from being opened too far by coming in contact with a side of the tube F, and when closed a stop is provided to bring the valve to rest when closed.

Referring to fig. 4 (the application of the valve to the coal supply of

vertical retorts), the valve A is fitted to the top of the coal-feed hopper G, from which the coal descends to the retort H.

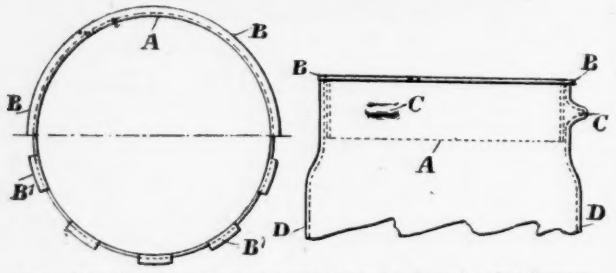
The method of operating the valve is as follows: Assuming that the valve is closed as in fig. 1, the coal falls through the tube F and rests on the inside surface of the valve B. To open the valve, it is rotated into the space F^2 by the lever E—"an operation easily performed owing to the valve not having to cut through or jam the coal." The coal will then fall through to the hopper G, and when it is supplied the valve is closed by the lever E; and any coal which is carried forward by the advancing or closing edge of the valve B is carried forward without resistance into the space F^1, and the coal thus carried forward falls through into the hopper G on the re-opening of the valve.

Protective Rings for the Glass Cylinders of Inverted Incandescence Gas-Burners.

NEW INVERTED INCANDESCENT GAS-LAMP COMPANY, of Farringdon Avenue, E.C.; a communication from CARL REISS, of Berlin.

No. 4257; Feb. 20, 1912.

Such protecting devices as at present constructed, the patentee points out, consist of a metal ring provided on its exterior with studs or bosses adapted to engage in depressions formed in the upper part of the interior of the glass cylinder. The operation of fitting the parts together, however, entails loss of time, "besides which the intimate contact between the metal ring and the cylinder prevents the proper expansion of the ring, and the heat communicated by this ring to the cylinder, in addition to that from the flame, causes the lugs on the glass cylinder to become so hot that they assume a semi-molten or plastic condition, so causing the cylinder to tilt, and often to crack, or to fall off." The object of the present invention is to remedy these disadvantages.



Reiss' (New Inverted Lamp Company) Protective Ring for Gas-Burners.

In order to keep the upper part of the glass cylinder comparatively cool, there is provided a protective metal ring A, which may be either a closed or a split one, and the upper edge of which is formed with an outwardly turned lip or flange B. The ring is fitted loosely in place within the mouth of the glass cylinder, and is maintained there by the lip or flange resting on the rim or edge of the cylinder, as shown. The ring is of such diameter that a slight clearance is left between it and the glass cylinder or the neck (when this latter is formed with one), in order to allow for the expansion of the metal ring without injury to the cylinder, "thereby prolonging the life of this latter."

The lip or flange B may be a continuous one, as shown in the upper half of the plan, or it may be an interrupted one—that is to say, there may be any suitable number of short lips or flanges B^1 around the ring, as shown in the lower half of the figure.

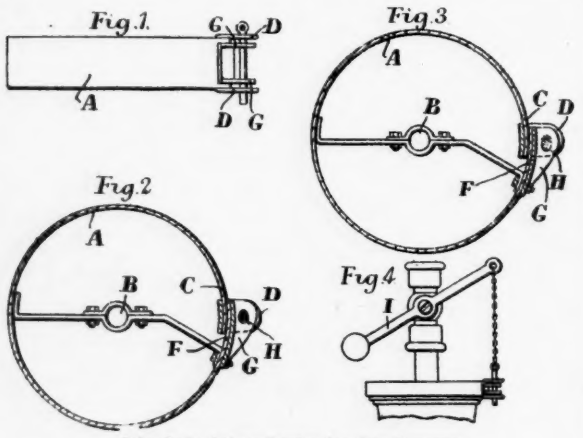
C are the usual lugs on the glass cylinder D, by means of which it is suspended from the inner reflector of the lamp.

Safety Device for Gas-Burner Taps.

SCHOELER, W., of Breslau, Germany.

No. 7447; March 27, 1912.

This device serves for locking the tap in the open position when the burner is lighted—the locking being effected by a clamping device acted upon by an intermediary body of a material which expands when it is heated.



Schoeler's Safety Device for Gas-Burners.

Fig. 1 shows one construction in side elevation. Fig. 2 is a section of fig. 1; the expansible body being shown in its normal state. Fig. 3 shows the expansible body expanded. Fig. 4 shows the device mounted upon a gas-lamp.

The expansible body consists of a band A, made of two different metals and soldered together in the form of a ring. It is mounted above the lamp by a support B, so that it is exposed to the action of the hot gases. One end C of the ring has lugs D, in which a pin is guided; the other end F having clamping jaws G, with guide-slots H for the pin. The lever I of the gas-valve has at one end the usual counterweight to maintain the valve in the closing position. The other end of the lever is connected with the pin by a chain or other convenient device.

Before the lamp is lighted—that is to say, as long as the ring A is not heated—its ends are in the position shown in fig. 2. The pin is loosely guided in the slots H of the clamping jaws G, and can freely slide in the lugs D when the gas-valve is being opened. When the burner is lighted, the ring A expands immediately through the heat and adopts the position shown in fig. 3. The ends of the slots H are thus strongly pressed against the pin, locking it by friction in the lugs D. The friction is sufficiently strong to compensate the action of the counterweight on the lever I, so that the valve is maintained in the open position by the pin being clamped in. In order to close the valve, additional pressure has to be exerted upon the counterweight so as to overcome the friction of the pin; and as soon as the flame has been extinguished the ring A contracts to its normal position, whereby the pin is released.

If it has been overlooked to shut off the gas from the lamp, and if the flame is extinguished by the closing of the valve of the main conduit, the ring A will contract as soon as it gets cool, whereby the pin is released, so that the valve is automatically closed through the action of the counterweight.

Gas-Fires.

FLAVEL, P. W., of Leamington.

No. 5875; March 8, 1912.

This gas-fire is of the kind adapted to be fitted to any existing grate by providing a sloping fuel support, consisting of a fire-clay block of approximately the dimensions of the grate. The block is formed with ribs or flutes to accommodate the fuel, which is retained by a flange at the lower edge of the block, which is also formed with apertures for the burner-nozzles to project through. The fuel employed comprises blocks of columnar form, fitting into the recesses in the block; being formed with upstanding projections, adapted to support rows of ordinary ball or cobble fuel—"thus providing supports for a double bed of fuel."

APPLICATIONS FOR LETTERS PATENT.

12,991.—REYNOLDS, A., "Regenerative furnaces." June 3.
13,049.—JOHNSON, G. W., "Treatment of gases." A communication from the Chemische Fabrik Griesheim-Elektron. June 3.
13,061.—HASSELL, A. N., "Pendants for gas." June 4.
13,073.—UPTON, G. V., "Gas-stove cover." June 4.
13,100.—HIGGINS, W., "Manufacture of gas." June 4.
13,124.—SCHROR, A., and RASCHEN, J., "Removal of scale from pipes." June 4.
13,134.—PLAISSETTY, A. M., "Inverted mantles." June 4.
13,136.—SVENSKA AKTIEBOLAGET GASACCUMULATOR and DALÉN, G., "Incandescent burner arrangements." June 4.
13,141 —COBB, J. W., "Extraction of ammonia and sulphur compounds from gas." June 4.
13,159.—WATERHOUSE, L., and BOOTH, J. B. S., "Carburation of air." June 4.
13,169.—NORMAN, J., "Gas-stoves." June 4.
13,173.—HARRIS, R. P., "Gas-fires." June 4.
13,174.—BILLING, E., "Producing air gas" June 4.
13,224.—LIEBE, E., "Gas-lighting systems." June 5.
13,229.—PINEAU, E., "Gas-producers." June 5.
13,283.—ANDERSON, D., "Gas-lamps." June 5.
13,290.—KNAPPICH, J., "Smelting and brazing with compressed gases." June 5.
13,449.—SIMPSON, F., and WOODS, A. R. T., "Recording small differences of fluid pressure, and operating control devices." June 7.
13,470.—STEWARTS AND LLOYDS, LIMITED, and STEWART, J. G., "Welded joints for pipes." June 8.

Porthcawl and District Water Supply.—The Local Government Board have granted an application for an additional loan for reservoir extension for the immediate supply of Porthcawl, Newton, and Nottage. The reservoir was deemed far too small; and the new work sanctioned will treble the capacity.

Gas Profits at Halifax.—The profits of the Halifax Corporation gas undertaking for the year ended March 31 amount to £17,746, compared with £15,968 last year—an increase of £1778. The balance brought forward, added to the profits, makes a total of £28,103, of which £8028 is to go in reduction of the rates, £3616 to the reserve fund, and £2000 to the working balance; and £13,639 will be carried forward. The reserve now amounts to £36,000, and the working balance to £6000.

Malvern Gas Supply.—At the last monthly meeting of the Malvern District Council, Mr. G. A. Jones drew attention to the gratifying fact that, owing to the foresight of the Chairman of the Gas Committee (Mr. Moerschell) and the Engineer (Mr. W. J. R. Baker), they had, by entering into a contract last September for a year's supply of gas coal at a slight reduction on the previous year's figures, been enabled to save the ratepayers £1500. The Committee recommended that consumers of gas for power purposes should be supplied with gas at 2s. 6d. per 1000 cubic feet, subject to a discount of 10 per cent. if paid within 28 days from the delivery of the demand note; and this was agreed to. Mr. Jones stated that it meant a difference of 1½d. per 1000 cubic feet; and there was a possibility of obtaining other customers.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

The Education and Certification of Gas-Fitters.

SIR,—The report on the Education and Certification of Gas-Fitters, presented by the Special Committee of the Manchester District Institution to the Council and members of the Institution of Gas Engineers, caused some discussion both on its submission and following the reading of Mr. Brearley's paper.

Judging by remarks made, there would appear to be some doubt as to the purpose of the scheme. The present "Gas Supply" examination is the only course which deals at all with the subject; and because many gas-fitters attempt to take the "Ordinary" grade, fear is expressed lest the new scheme should overlap or interfere with this syllabus and its students.

Mr. Head made it perfectly clear that the "Gas Supply" course was intended for distribution engineers, and not for gas-fitters as such.

The Council of the Junior Gas Associations suggest that the matter closely concerns them because of their gas-fitter members—evidently thinking that in their case gas undertaking fitters are in question.

As the President of the Manchester District Institution during the time when the Committee did their work—and whose name, with that of the Secretary, is appended to the report—I may be permitted to point out one or two facts in connection with the matter. I should certainly have done so during the discussion, but the opportunity was not afforded.

The scheme for the education and certification of gas-fitters was originally proposed by Mr. Kendrick in consequence of the limited knowledge possessed by fitters (not distribution men) employed by private gas-fitting firms and possibly by some gas undertakings.

In view of the fact that the greater injury was done to the gas industry by the former, who, through the variety of their work, have had no regular training in the use of modern gas appliances, the proposal was to institute classes for the benefit of all gas-fitters, in order as far as possible to ensure more efficient use of the gas supplied. At the same time, it was hoped that by increasing the knowledge of the gas-fitter, his status would be raised, and better men be induced to take up the work.

It was to this end that the assistance of the Ironmongers' Federation Association, the Institute of Plumbers, the Operative Plumbers' Association, the Master Gas-Fitters' Association, and other societies was sought. I think it would defeat the more important object we have in view if this fact be overlooked. If the scheme goes forward and (with or without the help of the City and Guilds of London Institute) classes are started in the various technical schools, we must have, and should endeavour to retain, the active co-operation of the Trade Associations concerned.

It will, I hope, be seen that the carrying out of the proposed scheme and syllabus need not interfere with the regular "Gas Supply" course, which is intended for those who are likely to become purely distribution engineers or officials.

Doncaster, June 15, 1912. ROBT. WATSON.

Mr. Townsend's Institution Paper.

SIR,—I should like to offer a few remarks regarding Mr. Townsend's Institution paper, read last Wednesday.

Mr. Townsend expresses surprise that the towns selling gas at the cheapest rates do not show a heavy day load. I do not consider this is at all surprising; for it is certain that by giving our consumers the benefit of low-priced gas, we in Sheffield hold, and retain, a very large proportion of the lighting load.

We also secure a big business in gas-fires; for, apart from their convenience and cleanliness, consumers find it economical to use them for heating their rooms. This more especially applies to houses that are electrically lit, where we often find that, after installing the electric light, so much more gas is required for warming the house that the annual gas bill is increased rather than reduced. This business keeps up the night load.

I fully agree with Mr. Bloor, of Carlisle, that the best answer to the paper is that given in the table of "Gas Consumed per Head of Population." Here is clearly shown the advantage of selling gas at very cheap rates.

Sheffield, June 15, 1912. J. W. MORRISON.

SIR,—The experiment in regard to the discussion of papers at the present meeting does not appear to have been quite understood; but might I point out that the fact a member applies for the print of any particular paper does not necessarily imply that he would be taking part in the discussion. On the other hand, too, a member would frequently not decide to take part in the discussion till after he had heard the paper read and some points arise in the discussion.

I intended to have added a few remarks to Mr. Townsend's paper somewhat as follows.

The author has most certainly assiduously applied himself to the solution of the problem forming the subject of his paper; and he is to be congratulated upon his efforts, which will, when published in the records of the Institution, prove very successful for reference purposes. Importance is properly given to the chief factor affecting the day load—namely, local conditions and characteristics. Thus in confining his information to Lancashire and Yorkshire, for his own guidance, the author shows a proper appreciation of this aspect of the case. The following figures in regard to Hastings may be of interest. It has been the practice for many years to discriminate between day and night sales; but the basis of calculating the day sale is open to criticism, being very much on the lines that Mr. Townsend has taken. However the figures are some criterion, and especially when we compare one year with another.

In 1910, the day sales amounted to 46·74 per cent. of the whole; the night sales consequently being 53·26 per cent. In the year following 1911, the day sales had risen to 47·27 per cent., and the night portion had fallen to 52·73 per cent. There is an actual increase in the day sales; and it is not due to the influence of other factors. In each year for a period of about fourteen weeks from the end of May to the end of August approximately, the day sales exceeded the night sales.

The conclusions arrived at by the author seem to be in common with our own experience; for in Hastings gas is supplied for all purposes at 2s. 10½d. per 1000 cubic feet; and we are a sliding-scale company, the operation of which seems against the spirit of preferential prices.

In the conclusion, No. 3 (as was subsequently explained) is, as it stands, opposed to No. 5; but it is probably meant that special prices should be given for power and industrial purposes; and this, in towns where such loads are likely, is no doubt the correct thing. Preferential prices, however, for cooking or heating, as against lighting, do not seem to have much to commend them—more especially as gas companies as a rule render special facilities for consumers to hire cookers or fires, and thus incur certain extra expense. If too liberal facilities are given by fixing and supplying cookers free and the like, someone has to pay, and it must prevent a general reduction in the price of gas.

With regard to heating—especially on the south coast—a heavy day load from this application of gas, may, with the extreme vagaries of the weather, cause great difficulty; and this bears upon the point the author mentions in regard to gasholder accommodation. The increase of the day load is not altogether the benefit that it appears at first, although of course increased consumption must always be a *desideratum*.

Hastings, June 15, 1912. CHAS. F. BOTLEY.

Alliance and Dublin Gas Company.

SIR,—I am deeply obliged to those who are taking up the question of the stock value of this Company's shares.

I have a large holding, and cannot understand the reason for the depressed condition of the market.

I hope the Directors will reply, and ease the minds of

June 14, 1912. SHAREHOLDERS.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following further progress has been made with Bills:—

Bills brought from the Commons, read the first time, and referred to the Examiners: Bognor Gaslight and Coke Company (Electricity) Bill, Gas and Water Provisional Orders Bill, Glasgow Corporation Water Bill, Scunthorpe Urban District Water Bill, Shipley Urban District Council Bill, Staffordshire Potteries Water Bill.

Bills read a second time and committed: Bedwellty Urban District Council Bill, Gas Orders Confirmation Bills (Nos. 1 and 2), Water Orders Confirmation Bill.

Bills reported: Bordon and District Gas Bill, Windermere District Gas and Water Bill.

Bills read the third time and passed: Egremont Urban District Water Bill, Houghton-le-Spring District Gas Bill, Wakefield Bill, Woking District Gas Bill.

Petitions against the following Bills have been presented: Fylde Water Board Bill, by the Preston Corporation; Gas Orders Confirmation Bill (No. 1), by the Aire and Calder Navigation, in respect of the Knottingley Gas Order; Water Orders Confirmation Bill, by the Reigate Corporation, in respect of the East Surrey Water Order.

The opposition to the Belfast Water Bill has been withdrawn.

HOUSE OF COMMONS.

The following further progress has been made with Bills:—

Bills brought from the Lords, read the first time, and referred to the Examiners: Houghton-le-Spring District Gas Bill, Wakefield Gas Bill, Woking District Gas Bill.

Lords Bills read a second time and committed: Brighton and Hove General Gas Bill, Herne Bay Gas Bill, Lea Bridge District Gas Bill, Maidenhead Gas Bill, North Middlesex Gas Bill, Southgate and District Gas Bill, South Suburban Gas Bill, York United Gas Bill.

Lords Bill reported: Ystradfellte Water Bill.

The Christchurch Gas Bill, Herne Bay Gas Bill, South Suburban Gas Bill, Swanage Gas and Water Bill, and Wandsworth, Wimbledon, and Epsom District Gas Bill (all brought from the Lords) have been referred to a Select Committee, consisting of Sir William Howell Davies (Chairman), Mr. Starkey, Mr. Penry Williams, and Mr. Campion; to commence sitting on Thursday.

The York United Gas Bill [Lords] has been referred to a Select Committee, consisting of Sir J. Compton-Rickett (Chairman), Mr. G. Gibbs, Mr. Pearson, and Mr. Cullinan; to meet on Thursday.

Lighting of the House.

Sir J. D. Rees has given notice of his intention to ask the honourable Member for St. George's-in-the-East (Mr. W. W. Benn), as representing the First Commissioner of Works, whether electric light will be substituted for gas in the Debating Chamber before the House can

make a practical trial of the effect of the former illuminant acting from the roof upon the eyes of members.

Robberies from Prepayment Gas-Meters.

On Monday last week, Mr. Joynson-Hicks asked the Home Secretary whether, in view of the large and increasing number of petty robberies from prepayment gas-meters in working-class houses, he would place himself in communication with the gas companies, with a view to arranging for the use of metal discs, or of devising some other scheme for putting a stop to the thefts? In reply, Mr. M'Kenna said this was a matter of importance, and had engaged his attention for some time. He was anxious to find a remedy for the various evils involved; and he proposed to request the gas companies to send representatives to confer with the Home Office on the subject.

A Bill to Promote Co-Partnership.

Last Wednesday, Mr. J. F. Hope, the Member for Central Sheffield, moved for leave to bring in a Bill to promote the adoption of co-partnership by statutory and other companies. He said the measure was of a very modest and tentative kind, and, except in regard to one condition, was entirely permissive. It set out a model scheme of co-partnership; and by one of its clauses all registered and statutory companies would be allowed to adopt the scheme without applying for any alteration in their Memoranda of Association, and, in the case of statutory companies, without applying to Parliament. Companies would be allowed to adopt a scheme of the kind subject to modifications approved by the Board of Trade. On one point, the measure went somewhat farther. In the case of non-statutory companies applying to Parliament for special powers, it had been the custom of Parliament to impose conditions which had been consolidated in the Companies Clauses Act. It was suggested that this Act should be amended so that the Bill should be adopted as a condition of a company getting its Bill through Parliament, though it would be possible to argue that the scheme was not applicable in a particular case. The permissive part of the measure dealt with companies, whether statutory or non-statutory. The root idea of the scheme was that there should be a standard return for labour in the form of wages and a standard return for capital. No attempt was made to set forth an arbitrary return in the form of wages. He thought this must be left to the process of collective bargaining. It was proposed in the Bill that the standard return for wages should be 5 per cent., and that, once this had been secured, all profits above it should be divided rateably between a company and its employees; so that for every additional 1 per cent. profit an addition of 1-20th should be made to the wages paid. Following the precedent set by the South Metropolitan and other gas companies, some part of the bonus which would be paid would go into the hands of trustees, to be invested by them either in trustee stocks or in the stock of the company itself. He would not attempt to dogmatize upon the subject with which the Bill dealt. The measure was put forward with a view to invite criticism and suggestions, and to draw out all the difficulties there might be in the matter. He felt, and many felt with him, that it was necessary that the community of interest between capital and labour should, if possible, be made plain, material, and automatic; and that all engaged in industrial enterprises should feel that they were working for one another and for a common interest in which they all shared. Leave having been given, the Bill was brought in and read the first time.

Refusal to Sanction an Electric Lighting Order.

A question was put to the Parliamentary Secretary to the Board of Trade (Mr. J. M. Robertson) on Monday last week, by Lord Wolmer, as to whether the application of the Newton-in-Makerfield Urban District Council for a Provisional Order to authorize them to generate and supply electricity had been refused on the ground that there was an insufficient local demand for current; if so, whether he could state how great a demand would have to be guaranteed by local consumers, and for how long, to enable the Board of Trade to reconsider their decision; and whether any other conditions would have to be fulfilled before the decision was reconsidered, and, if so, what was their nature. Mr. Robertson, in reply, said: The answer to the first part of the question is in the affirmative. The report of the Consulting Engineer of the Council showed that the success of the scheme depended on certain large commercial firms taking a supply of electricity for power purposes, there being, in his opinion, no probability of any considerable demand for lighting purposes; and the Council were unable to satisfy the Board that they would be able to supply at a price which would secure these firms as consumers without imposing a burden on the rates. It is not possible for me to state definitely what demand would be sufficient to justify the Board of Trade granting an Order; and, in any case, I cannot hold out any hopes of one being granted this session. Lord Wolmer thereupon asked how the Council could be expected to satisfy the Board, if they refused to inform them as to the conditions to be fulfilled. Mr. Robertson said there were no standards.

LOCAL GOVERNMENT (GAS) PROVISIONAL ORDERS.

Chemical Clauses Inserted.

A number of Local Government Provisional Orders dealing with gas undertakings came last Thursday before the Unopposed Bills Committee of the House of Commons, presided over by Mr. M'Lean, in the absence of the Chairman of Ways and Means (Mr. Whitley).

Coalville.

In the Local Government Provisional Orders Confirmation Bill (No. 3) is an Order relating to the Urban District of Coalville. It is for the purpose of partially repealing and altering the Coalville Urban District Gas Act, 1899. Under the Act, the undertaking of the Whitwick and Coalville Gas Company was vested in the Council; and the present Order enables the Council to take, for the purposes of the undertaking, additional lands adjoining the existing gas-works. Article II. of the Order reads as follows: "Notwithstanding anything in the Local Act, the Council may hold and use the lands described in the schedule to this Order for all or any of the purposes of their gas undertaking, including the manufacture and storage of gas and residual products, as if such lands were included in, and formed part of, the lands described in the schedule to the Local Act; and the provisions of the Local Act shall apply and have effect accordingly.

Mr. Wood, of the Local Government Board, in presenting the Order, said the Board desired to make an amendment by inserting after the words "residual products," the words "produced in, or resulting from, the manufacture of gas by them."

There was no comment on the part of the Committee regarding this amendment; and the Order was sent forward for third reading.

Among other provisions of the Order may be mentioned the fixing of the illuminating power at 14 candles, and the adoption of the "Metropolitan" argand burner No. 2. The Council are also empowered under the Order to require the user of a gas-engine to fix an anti-fluctuator for controlling the supply. There is also authority to raise the necessary sums to pay off any moneys previously borrowed, and also to replace those which during the previous twelve months were temporarily applied from other funds of the Council for the purposes of the gas undertaking.

The Local Government Provisional Orders (Gas) Confirmation Bill relates to the towns of Bala, Harrington, and Hipperholme.

Bala.

The Bala Council have agreed to buy the undertaking of the Gas Company; and the Order authorizes them to maintain and continue it after acquisition. Powers are given to supply fittings; the illuminating power of the gas is fixed at 14 candles; and the test-burner is to be the "Metropolitan" No. 2, with power to the Board of Trade to approve any other. The maximum price is 5s. 6d. per 1000 cubic feet, and the price charged for public lighting is not to be more than 10 per cent. less than that charged to private consumers. The pressure is prescribed at 6-10ths from midnight to sunset, and 8-10ths from sunset to midnight. Similar provisions to those in the Coalville Order are inserted as to borrowing.

Mr. Wood said the same point concerning residual products was raised as in the previous Order. Among the definitions was the following: "The expression 'residual products' includes coke, culm, asphaltum, pitch, tar, oil, ammoniacal liquor, or any other refuse or residual matter or thing produced in, or resulting from, the manufacture of gas;" and it was proposed to add at the end the words "by the Council," to prevent them dealing in residuals other than those resulting from the manufacture of gas by themselves.

The Chairman asked if the Local Government Board were satisfied that there was not likely to be any inconvenience to the undertaking from this.

Mr. Wood said that in all the cases then under consideration they were satisfied that there would be no inconvenience. They were all small concerns; and it was very improbable that the owners would want to embark on such a business as the working-up of residual products from other undertakings. The Local Government Board would want to reconsider the question of these Councils carrying on such commercial undertakings unless the addition was made.

Mr. Beale (a member of the Committee) pointed out that the proposed alteration was merely one in the definitions, and might bring about some unexpected consequences when read in conjunction with the clauses, as it placed a restriction upon the Council.

Mr. Wood replied that it was merely a restriction of the powers now being conferred upon the Council.

The matter was allowed to rest; and the Order was sent forward for third reading.

Harrington.

In this Order, a similar amendment to that just referred to was also made. The Harrington Council have agreed to purchase the undertaking of the Harrington Gaslight Company, Limited; and the Order is in exactly the same form as that for Bala.

Hipperholme.

In this case, the Hipperholme Council have applied for a Provisional Order authorizing them to carry on a gas undertaking, and purchase gas in bulk and supply it in the Bailiff Bridge gas area. As the Council only propose to purchase gas in bulk, and not to manufacture the question of residual products did not arise on the Order. The maximum price is 5s. 6d. per 1000 cubic feet; and the price for public lighting is not to be less by more than 10 per cent. than that charged to private consumers. The illuminating power is to be equal to that of the gas as purchased; and the test-burner is the "Metropolitan" No. 2. The usual borrowing powers are included in the Order, which was also sent forward for third reading.

SOUTH SUBURBAN AND BAWTRY GAS BILLS.

The Standing Orders Committee last Wednesday, decided to dispense with the Standing Orders on a petition presented by the Bromley Corporation, which will allow them to appear before the Select Committee on the South Suburban Gas Bill, which is in a group which will be considered on Thursday. The Bawtry Gas Bill was also before the Committee. There are at present in Bawtry small private gas-works owned by two ladies; and the promoters of the Bill were unable to obtain their consent for the purchase of these works, thus not complying with Standing Orders. The Committee, however, decided to dispense with the Standing Orders on this point, and allowed the Bill to go forward.

At a sale at St. Austell last Tuesday, some £5 shares in the Camborne Gas Company fetched from £5 to £5 2s. each; and some "B" shares (£1, but 16s. paid) in the St. Blazey Gas Company, 19s. and £1 apiece.

LEGAL INTELLIGENCE.

GUNNING'S AUTOMATIC STREET-LAMP LIGHTERS.

The Court of Appeal, consisting of the Master of the Rolls and Lords Justices Farwell and Kennedy, heard on Wednesday last an appeal by the plaintiffs in the action brought by the British, Foreign, and Colonial Automatic Light-Controlling Company, Limited, and John Gunning, against Metropolitan Gas-Meters, Limited, from the decision of Mr. Justice Warrington dismissing the action. [See "JOURNAL," Vol. CXVI., p. 842.] The action was brought to restrain an alleged infringement of letters patent of 1899 and 1908 for improvements in apparatus for automatically lighting and extinguishing gas-lamps at predetermined times, and for improvements in conical plugs. The defendants denied infringement, and pleaded that the invention was not new by reason of prior publication. It was said the result of the invention was (1) the operating of a gas-tap by the direct action of the spring, and so getting the full power of the spring; (2) the capacity for fixing the clock at the time of day when the man came round once a week to wind it up; and (3) the capacity for adjusting from time to time the hands that move the cap according to the period of the year when it is desired that the operation shall take place. For the defendants, it was urged that turning on taps by clockwork was as old as the hills; and that at the date of the patent nothing was left to the plaintiffs but specific mechanism.

Mr. T. TERRELL, K.C., and Mr. C. TERRELL appeared for the appellants; Mr. A. J. WALTER, K.C., and Mr. J. HUNTER GRAY represented the respondents.

The MASTER OF THE ROLLS said the patent was for specific mechanism of a very narrow and defined nature, and was by no means a patent for a general combination. Treating it as such, the Court had to ascertain whether the defendants had copied the mechanism or merely made a colourable imitation of it. So far as he could see, that which was claimed as the vital part of the invention was not to be found in the defendants' apparatus. Looking at the matter as a whole, construing the patent strictly, and confining the plaintiffs to what had been claimed, he thought Mr. Justice Warrington was quite right in saying that there was no infringement.

Lords Justices FARWELL and KENNEDY concurred; and the appeal was dismissed, with costs.

DAMAGE TO ROADS AFTER MAIN-LAYING.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Monday, June 10.

(*Before Lords Justices* VAUGHAN WILLIAMS, FLETCHER MOULTON, *and* BUCKLEY.)

Mayor and Corporation of Swansea v. Harper.

This was an appeal by the plaintiffs from the judgment of the Lord Chief Justice, Mr. Justice Pickford, and Mr. Justice Avory, given on the 12th of January, and reported in the "JOURNAL" for the 16th (p. 160), confirming the decision of the Justices, under the following circumstances: By section 28 of the Water-Works Clauses Act, 1847, power is given to suppliers of water to open the roads within the limits of their Special Act, and lay pipes, "doing as little damage as can be in the execution of the powers hereby or by the Special Act granted, and making compensation for any damage which may be done in the execution of such powers." By section 85, "with respect to the recovery of damages not specially provided for," the Railways Clauses Consolidation Act, 1845, is incorporated with both the General and the Special Acts; and by section 140 of the former Act the amount of the damage, in case of dispute, is to be ascertained and determined by two Justices. The undertakers for the supply of water to the borough of Ystradgynlais, acting under a Special Act incorporating the Lands Clauses Consolidation Act and the Water-Works Clauses Act, broke up the soil of a public road which was within the district of, and repairable by, the County Council, and laid a water-pipe therein; and the road was then restored to its original condition. The whole of the work was carried out in a proper, efficient, and workmanlike manner, under the superintendence of the Surveyor to the County Council. Eight months after its completion, a portion of the road and the bank supporting it slipped into the adjoining river; and the County Council repaired the damage, which was the result of laying the pipe, at a cost of £87. The Council preferred a complaint before two Justices to recover the cost of repairing the damage; and it was allowed. A case was, however, stated for the Divisional Court, who held that the claim was properly made under section 28 of the Act of 1847, as being a claim for compensation for damage done in the execution of the undertakers' powers; that the compensation claimed was damages, the recovery of which was not specially provided for within the meaning of section 85 of the Act; and that therefore, under section 140 of the Railways Clauses Consolidation Act, two Justices had jurisdiction to ascertain and determine the amount of damages.

Mr. MACMORRAN, K.C., and Mr. S. FLEMING appeared for the appellants; Mr. J. SANKEY, K.C., and Mr. S. J. FRANCIS WILLIAMS represented the respondents.

At the conclusion of the arguments,

Lord Justice FLETCHER MOULTON said the claim was based on an alleged right of the respondents to recover from the appellants, by virtue of the provisions of section 28 of the Water-Works Clauses Act, 1847, the amount at which it had been assessed by the Justices. In order to establish the claim, they had to show two things—first, that section 28 did entitle them to a pecuniary remedy in respect of the facts of the case; and, next, that they had gone to the right tribunal to enforce their claim. As to the first point, he was of opinion that section 28 did not apply to such a claim as the present. The facts found by the Justices were stated in very clear language, and one could not misunderstand the finding; and, though he confessed that he did not understand how the destruction of the road was caused, he must take it that the pipe had been properly put down by the appellants, and the road duly restored; that they were not guilty of any negligence or default with regard to the pipe; but that a consequence of the pipe being there, rightfully and duly maintained, was the damage represented by the £87 claimed. On looking at section 28, and considering the words carefully, he thought the section referred to the acts to be done by the appellants in breaking up the streets to lay down their pipes, in reinstating the streets, in taking up the ground again for the purpose of maintenance, and once more properly reinstating them, but was not intended to relate to the natural and inevitable consequence of the presence, under statutory powers, of the pipes in the streets, and only to the acts done in putting and maintaining them in the road. The words "do as little damage as can be" referred to the acts previously mentioned in the section; and therefore he had to consider whether what had happened was something causing damage done in the acts to which section 28 alone referred. In his opinion it was not, as it was clearly found that the pipes were properly laid, and that the road was properly reinstated. The undertakers were not liable for damage unless there had been some neglect or default. Here the damage was simply due to the fact that the pipe was in the road; it was not done in "the execution of the powers" of the appellants within the meaning of section 28. As to the second point, he thought the Justices were not the proper tribunal to apply to for the enforcement of a claim to recover damages. The appeal must therefore be allowed, with costs.

The other Lords Justices gave judgment to a similar effect.

POISONING BY COINS FROM PREPAYMENT METERS.

At the Bow County Court, last Friday, before his Honour Judge Smyly, K.C., an arbitration under the Workmen's Compensation Act of special importance to gas companies was heard. The applicant was Mrs. Emma Florence Robinson; the respondents were the Gaslight and Coke Company. The claim was for compensation for the death of applicant's husband from metallic poisoning.

Mr. METCALF appeared for Mrs. Robinson; Mr. VAUGHAN-WILLIAMS represented the Company.

It appeared that the deceased, Abraham Robinson, had been in the employ of the Company a good many years as a collector from prepayment meters. A number of the coins taken from the meters became green from damp and other causes, and were poisonous. The deceased man, who had a moustache, was in the habit of frequently curling it, and often did this after emptying meters. On the 15th of March, he was forced to give up work in consequence of illness, which he attributed to poisoning contracted by the habit referred to. He became so bad that he had to consult Dr. Feeley, to whom he stated that he felt sure he had absorbed poison from the coins taken from the meters. He was ordered to bed, and all that was possible was done for him; but he gradually sank, and died on the 2nd of April. An inquest was held, as reported in the "JOURNAL" for the 16th of April (p. 177), and the Jury returned a verdict of "Death from metallic poisoning."

Dr. *Feeley* and Dr. *Cheetham* both gave evidence as to the effect of the poison coming off the pennies. The former expressed the opinion that the poisoning in the present case must have been gradual, and that the quantity absorbed on the 15th of March was not sufficient to kill deceased.

Mr. VAUGHAN-WILLIAMS contended that no case had been made out against the respondents; and he quoted from a large number of recorded judgments to show that only scheduled diseases could be brought within the purview of the Workmen's Compensation Act. It might, he said, be very unfortunate for the widow; but the fact remained that she did not come within the Act, except under the obligation placed upon her to prove the exact time, place, and circumstances under which the disease was contracted. Both the medical men had been satisfied that the poisoning must have been gradual; and he contended that the man's body became practically saturated with it. There seemed to be no doubt that he died of the disease; but there was no possibility of stating the exact time, place, and circumstances under which it was set up.

Mr. METCALF argued that the cases cited by the learned Counsel were different from the present one, inasmuch as the coppers would not have been in the least dangerous if they had been handled just as they came from the Mint. It was the condition into which they got, as the result, in a large measure, of the nature of the respondents' business, that had caused the mischief. It was quite clear that the employers had no apprehension of any danger arising from the collection of the pennies, and the absorption of this poison, or they would have taken steps to avoid it or safeguard themselves; but nevertheless the danger was palpably present, and had caused the man's death. He had been absorbing the poison for months, and there was a probability that he received a fatal dose on the 15th of March.

Judge SMYLY, in giving judgment, said the case was a very sad one, and very unfortunate for the widow, inasmuch as he could not make an award in her favour. He was bound to find that the metallic poison was absorbed during the many months, or possibly years, that the man had been engaged in collecting pennies from prepayment gas-meters. There seemed no doubt that this occurred in the course of his employment, and that he contracted the disease through his habit of twisting his moustache. But when he absorbed a sufficient dose of the poison to be fatal could not be shown; and therefore, according to the wording of the Act, he was sorry to say the applicant must fail.

At the request of Counsel, his Honour agreed to find that neither the deceased nor his employers had contemplated that such an incident would occur.

His HONOUR added that, had he been able to find in favour of the applicant, he would have been only too pleased.

Mr. VAUGHAN-WILLIAMS said it had been originally intended not to press for costs; but as the case might go to the House of Lords, he thought it advisable to do so.

Judgment was then entered for the respondents, with costs.

PUBLIC AND PRIVATE WATER SUPPLIES.

At the Bacup Town Hall, on the 6th inst., Mr. Bidwell, of the Local Government Board, heard an appeal at a special inquiry in which Mr. George Baron, Solicitor, appeared for trustees of certain property in Daisy Bank, Bacup. Mr. J. Entwistle, Town Clerk, represented the Bacup Corporation.

Mr Baron said the question they raised was whether, in an exceptional period of drought as last summer, the private supply not having absolutely failed, the Corporation were entitled to say, under their powers, that therefore their supply was not a reasonable supply. All the property was leasehold; and there was a private supply which had existed for 80 to 100 years—the lease by the ground landlord to the leaseholder giving the right to search for and get water in the hillside. This right had been exercised by taking water from the reservoirs in existence. The appellants said there was a decision to enforce expense, as the Corporation had cut off the private supply and connected their own. They appealed against this procedure. Furthermore, the Corporation had an excessive supply which would serve a borough three times the size of Bacup. The private supply had never absolutely failed.

The Town Clerk said the Cowper water scheme was designed for a population of 45,000, and Bacup had 22,000 people. He resented the idea that they had done what they did because of a surplusage of water. They had a duty under the Public Health Act; and two years ago there was an outbreak of typhoid fever in the town, caused by a private water supply. Instructions were given to watch the private supplies, as being suspicious. They had one or two deaths from the outbreak. They did not consider there was an adequate supply to the houses in question; and notice was served in the ordinary way, so as to remove a possible source of danger to the inhabitants. There had been times when the private supply had failed to reach some of the houses.

Mr. Baron remarked that the private storage tank had a capacity of 16,000 gallons.

The Town Clerk said that taking the 19 houses at 4½ persons per house, it would equal 85 inhabitants; and the ordinary supply was 1700 gallons per day, which was rather more than one-tenth of the storage.

The Inspector: It seems a storm in a tea cup for £1 5s. And you are making it a test case?

Mr. Baron said he was, as he had been instructed by several clients who had been aggrieved, though some said they would rather submit than fight the matter out.

The Town Clerk pointed out that they were not concerned with what was a reasonable supply, but to see that where there was not a proper supply, notice was served on the owner to put one in

Mr. Baron: If the Inspector maintains your contention that 16,000 gallons reserve is not sufficient, the inquiry fails.

The Inspector said he would not do that. He would report to the Board in the ordinary way.

Evidence was then taken.

USE OF BATH WATER FOR GARDENS.

At the Westminster County Court, last Friday, before his Honour Judge Woodfall, Mr. Ernest Hills, of Trevor Villas, Woodford Green, was sued by the Metropolitan Water Board for 10s for water used by him for his garden. Mr. Desmond Collins, the Board's Solicitor, said there had been some correspondence, in which defendant stated that he had no flowers in his garden or greenhouse, and only used water for a piece of grass about 3 yards square, and that the water was drawn from the bath after it had been used. Under the Board's Charges Act and the Water-Works Clauses Act, defendant was liable, even had he done what he stated. He was entitled to a domestic supply and also to a garden supply of water if he wished to have them, and a minimum charge of £1 2s. 11d. could be made for the latter supply. But the Board's usual course was to base the charge upon the size of the garden. The defendant's garden was a fairly large one, for which the charge, in the ordinary course, would be the amount claimed. His Honour asked whether, supposing the defendant had a pipe from his bath, and used the waste water from it, he could do so. Mr. Collins replied that he was not entitled to use the water for the garden unless he paid for a garden supply. It was using domestic water for a non-domestic purpose. He appreciated that it was a nice point, but he did not think his Honour would find it necessary to decide it in this case. Defendant said he fixed his hose to the waste-pipe of the bath to water the grass; but the grass was in the front of the house, and he had a large garden in the rear, where an inspector found the hose. An inspector in the employ of the Board gave evidence that he visited defendant's house one evening last June. Going to the side entrance, he saw a garden hose, one end of which passed into the kitchen and the other into the greenhouse. Water was trickling from the hose, and the garden path was damp. Defendant said he had a piece of grass, 12 feet by 9 feet—the only part of his ground under cultivation during the last two years—for which he used some waste water from the bath. The evidence about the hose was absolutely untrue. He only had one attachment for the hose, which he produced, and would like the inspector to say whether it could be fixed to the tap in the kitchen. Recalled, the inspector said it could not. Defendant asserted that this was the only connection for the hose he had, and he had not connected it with the kitchen tap, which he had had fixed for two years. The hose was 60 feet long, and he had disposed of it. His Honour gave judgment for plaintiffs, with costs—adding that, in doing so, he did not decide the case on the question of the use of waste water.

The Doncaster Corporation have been recommended by the Gas Committee to accept the tender of Messrs. W. C. Holmes and Co., of Huddersfield, for the supply and erection of a 2 million cubic feet Livesey tar-extractor, for £246, and a scrubber-washer, for £775.

MISCELLANEOUS NEWS.

CO-PARTNERSHIP AS A REMEDY FOR LABOUR UNREST.

A Co-Partnership Bill.

As will be seen from our "Parliamentary Intelligence," a Bill to promote the adoption of co-partnership has been introduced by Mr. J. F. Hope; with the support of Mr. Amery, Mr. Cave, Lord Robert Cecil, Mr. Worthington Evans, Mr. Peto, and Lord Wolmer.

Formation of a Consultative Council of the Labour Co-Partnership Association.

It was mentioned in the "Journal" last week (p. 733) that arrangements had been made for holding a meeting of manufacturers and others at the House of Commons, with the object of forming a Consultative Council of the Labour Co-Partnership Association to promote co-partnership in the industries of the country generally. In view of the meeting, the following statement was issued by the Association.

Co-partnership has been described as an improvement on profit-sharing. It is, in fact, an attempt to give to labour a share, not only in the profit of industry, but in its responsibilities also. Industrial enterprise depends for its success on the hearty co-operation of all those engaged in it. So long as capital regards labour as little more than human machinery, and labour believes that capital is its natural enemy, genuine co-operation between the two is impossible. Convince both that each has its rights and each has its duties, and that each is necessary to the other, and a great advance will have been made towards industrial peace. This is the aim of co-partnership. It recognizes that the success of industry depends upon labour as much as upon capital; and it therefore gives to labour a share in the profits proportionate to its industrial importance. On the other hand, it is right that if labour shares in profits, it should also share in losses. This cannot be arranged justly or prudently by any diminution of the standard wages of labour; for these are the means of livelihood of the wage-earner, and without them his efficiency, if not his health, will suffer. But if labour's proportion of the profits of the enterprise is paid partly or altogether by the allotment of capital, losses which fall on capital will fall on labour also.

As a shareholder the workman, of course, obtains the ordinary rights of a shareholder, including the right to vote in the election of the board of directors. In some companies this has been carried much farther, by giving the workmen shareholders the right to a separate representation on the board of directors elected by themselves. In the instances where this has been tried, it has been found to work excellently; but it is not put forward at the present day as an essential part of co-partnership.

Complete co-partnership then involves: First, the payment of the existing standard wages to labour; secondly, the payment of a fixed rate of interest on capital; thirdly, the division of the surplus profit between capital and labour in agreed proportions; and, fourthly, the payment of part of labour's share in the surplus profits by the allotment of shares in the capital. It does not involve any lowering of wages. Any scheme of that kind is a spurious form of co-partnership. Nor does it involve any interference with complete freedom of combination for the wage-earners. On the contrary, some of the most convinced trade unionists are keen co-partners. Nor does it involve handing over the control of any business to the wage-earners, for this would be to sacrifice the training and experience of the present highly-skilled managers of industry.

Co-partnership is not a panacea for industrial ills. It is a recognition of the claims and the dignity of labour, while preserving the rights of capital. Where it has been tried, it has in many cases lessened friction and increased prosperity. In the gas industry, it is an established success; more than half the capital of gas companies being now administered on co-partnership principles. In many other trades, a large measure of success has been achieved. The object of the present movement is to assist in the further application of similar principles to the industries of the country.

The meeting referred to in the opening paragraph was held last Wednesday, under the chairmanship of Earl Grey, the President of the Labour Co-Partnership Association, and was largely attended.

The proposal before the meeting was, as already mentioned, the formation of a Consultative Council of the Association to promote co-partnership; and, after a full discussion, it was resolved, on the motion of Lord Robert Cecil, seconded by Mr. Charles Carpenter, and supported by Sir W. H. Lever and Mr. T. C. Taylor, to carry out the idea. Emphasis was laid upon the fact that the movement was entirely outside party politics. A Committee, consisting of Lord Grey, Mr. Alfred Lyttelton, Lord Robert Cecil, Mr. T. R. Ferens, Sir W. H. Lever, Mr. James Hope, Mr. Basil Peto, Mr. W. Pearce, Mr. T. C. Taylor, the Hon. E. Strutt, and Mr. Charles Carpenter, with representatives of the Labour Co-Partnership Association, was elected; and a vote of thanks to Earl Grey concluded the business. His Lordship, in acknowledging the vote, said he had long regarded co-partnership as the right principle, and hoped they would be able to dispel the ignorance of both employers and workmen upon the subject.

The scheme proposed by Lord Robert Cecil for the work of the Council was as follows:—

1.—To advocate and explain co-partnership by the usual methods—*e.g.*, meetings, letters and articles in the Press, distribution of pamphlets and leaflets, &c.
2.—To investigate the causes of failure and success in the various co-partnerships that have been established or attempted.
3.—To advise any employers or workmen desirous of trying co-

partnership in any business (*a*) by personal interviews or correspondence or (*b*) by preparation of model schemes.
4.—To co-operate in any public inquiry that may be instituted.
5.—To consider how far co-partnership can be usefully assisted by Government action, either administrative or legislative.
6.—To appoint sub-committees for any or all of these purposes.

MANCHESTER CORPORATION GAS UNDERTAKING.

Annual Report.

We have received from the Superintendent of the City of Manchester Gas Department (Mr. F. A. Price) the report and accounts of the Gas Committee for the year ending March 31. The principal portions of the report, which bears the signature of Mr. William Kay, the Chairman of the Committee, are given below.

Your Committee have pleasure in presenting herewith the abstract of accounts for the year ending March 31, 1912, together with the usual particulars as to the year's working.

FINANCIAL.

The following is a summary of the items of income and expenditure; the figures for the previous year being given for the purpose of comparison :—

Income.

1911.		1912.
£617,161	Gas, &c.	£613,679
98,658	Coke	106,661
33,307	Tar	39,388
40,455	Ammoniacal liquor and sulphate of ammonia	44,600
1,015	Sundry receipts	926
£790,596	Total	£805,254

Expenditure.

	Manufacture—	
£270,630	Coal, cannel, and oil	£265,107
106,180	Carbonizing wages, maintenance of plant, &c.	107,596
29,325	Renewals	46,402
	Distribution—	
62,194	Maintenance of plant, salaries and wages, &c.	63,196
46,828	Renewals	36,608
	Management—	
16,412	Salaries and wages	16,584
11,106	Other charges	12,452
57,800	Rents, rates, and taxes	62,038
£600,475	Total	£609,983
£190,121	Showing a gross profit for the year of	£195,271
46,236	From which has to be deducted the amount paid for interest on loans, &c.	44,111
£143,885	Leaving a net profit of	£151,160

The net profit has been appropriated as follows :—

1911.		1912.
£71,559	Sinking fund for redemption of loan debt.	£74,824
46,500	City fund in aid of rates	50,000
7,881	Applied in extension of works where borrowing powers are not granted	16,261
3,537	Premiums, &c., on purchase of 4 per cent. stock for cancellation	1,526
8,404	Deficit from previous year	—
6,004	Reserve fund account	8,549
£143,885		£151,160

The quantity of gas sold during the year was 5,423,204,000 cubic feet, and the average price realized 2s. 3·13d. per 1000 cubic feet. The cost of coal, cannel, and oil per ton carbonized was 10s. 8·04d., against 10s. 10·24d. for the previous year, while the income from residual products rose to 7s. 8·08d. per ton, compared with 6s. 10·98d. per ton; representing a saving of 11·30d. per ton in the net cost of raw material, which on the total carbonization of 496,918 tons amounts to £23,396.

The amount transferred from revenue to the credit of the renewals account is £84,301, which, together with the interest on the fund, makes a total credit for the year of £87,363. The sum of £46,182 was expended during the year. The balance to the credit of the account is now £143,258.

The balance of the net profit appropriation account—*i.e.*, £8549—has been transferred to the reserve fund, which now stands at £14,553.

The expenditure on the capital account during the year amounted to £51,095. Of this sum, £16,261 was provided out of net profits, and the balance out of loans. The total capital outlay at March 31, 1912, was £2,950,712, the loan debt in respect of which was £1,118,681. The balance of the sinking fund not actually applied to the redemption of debt at the same date was £1105.

As already sanctioned by the Council, an application to the Local Government Board will shortly be made for further powers to the extent of £200,000, to provide additional capital for distribution plant —*i.e.*, main and service pipes, meters, cookers, and fires. This sum, it is estimated, will meet requirements for the next five years.

PRICE OF GAS.

In accordance with the resolution of the Council of May 3, 1911, the price charged for gas used within the city for manufacturing purposes only was reduced from 2s. 3d. to 2s. per 1000 cubic feet as from June 25, 1911, provided that the annual consumption was not less than 500,000 cubic feet. The quantity of gas supplied through automatic meters for 1d. has been increased from 30 to 33 cubic feet within the city, and from 25 to 28 cubic feet beyond, as from Sept. 30, 1911. To effect this increase, the mechanism of 62,373 meters had to be changed, at a cost of £2066. This concession to the consumers is of the estimated present annual value of £8300. In accordance with the resolution of the Council of April 3, 1912, the price of gas consumed by public lamps within the city has been reduced as from March 31, 1912, from 2s. 3d. per 1000 cubic feet to a price that will cover the entire costs of manufacture, distribution, and management, and all other charges appertaining thereto, including capital and renewals charges.

WORKMEN'S WAGES AND THE MINERS' STRIKE.

An advance in workmen's wages and concessions in hours of labour have been granted as from March 1, 1912, of an annual value of about £6000. During the miners' strike, delivery of coal was entirely suspended for five weeks, but the Committee were able to maintain the normal supply of gas during the whole period of the strike. Special arrangements were made for the supply of coke in small quantities to poor people without increasing the price. The number of measures sold was 495,895, varying in weight from 14 lbs. for 1d. to 56 lbs. for 3d. The total weight sold under these conditions was 5961 tons, and the amount received was £3445, or about £2500 below the current market price.

MANUFACTURE.

The quantity of coal carbonized, including the equivalents of oil, and gas made were as follows :—

	Material Carbonized. Tons.	Gas Made. Cubic Feet.	Make per Ton. Cubic Feet.
1912	496,918	5,693,190,000	11,457
1911	498,709	5,659,844,000	11,349

Owing to the improvement in carbonizing, the increased make of gas—viz., 33,346,000 cubic feet—was obtained with a reduction in the quantity of material equivalent to 4729 tons. The illuminating power of the gas sent from the works, as tested by the "Metropolitan" No. 2 burner, was equivalent to 17·13 standard sperm candles. It is gratifying to note the continued reduction in manufacturing costs, which have shown a steady decline during the past twelve years.

DISTRIBUTION.

The total output of gas and the quantity unaccounted for, compared with the previous year, were as follows :—

	Transmitted from Works. Cubic Feet.	Unaccounted for. Cubic Feet.	Percentage of Loss.
1912	5,686,880,000	182,944,000	3·22
1911	5,663,570,000	183,397,000	3·23

Increase in output, 0·41 per cent.

The continued development of the gas undertaking is shown by the increased number of consumers, and the additional cooking-stoves, gas-fires, and other appliances now in use.

The number of gas consumers on March 31, 1912, compared with 1911, was as follows :—

	Within the City.	Without the City.	Total.
1912	172,827	10,966	183,793
1911	170,693	10,663	181,356
Increase	2,134	303	2,437

The number of automatic meters in use on March 31 was 66,153, or an increase of 2490; and the quantity of gas registered was 658,553,000 cubic feet—an increase of 68,491,000 cubic feet, or 11·61 per cent.

The number of gas-cookers owned and fixed by the Committee at the 31st of March was 58,799—an increase of 5069 on the previous year. The estimated consumption of gas by these cookers is 737 million cubic feet, or an equivalent of 64,500 tons of coal; being an increase of 42 million cubic feet, or 6·04 per cent., on the previous year's figures. There have also been fixed 31,653 grillers in connection with automatic and small ordinary meters. About 49 per cent. of the consumers now have the free use of a cooker or griller.

In order to popularize the use of gas for heating, and having regard to the smoke abatement movement and the general desire for a purer atmosphere, your Committee resolved to hire-out gas-fires on the most favourable terms as from September, 1911. At the 31st of March last, 2319 fires had been fixed.

On the date just named, the number of gas-engines in use was 1528, compared with 1573 the previous year. The quantity of gas used by these engines was 390,235,000 cubic feet—an increase of 9,241,000 cubic feet, or 2·42 per cent.

EXTENSION AND RENEWAL OF WORKS.

During the year, the following work has been carried out at the several stations :—

Gaythorn.—At this station an ammoniacal liquor tank of a capacity of 13,000 gallons has been constructed over the exhauster-house, to improve the facilities for loading this product into the barges for conveyance to the chemical works at Bradford Road.

Rochdale Road.—During the year, the horizontal retort-settings in the "C" retort-house were worked out, and the plant is being dismantled in preparation for an installation of vertical retorts with which it has been decided this house shall be equipped. The carbonizing capacity of the house with horizontal retorts was 2 million cubic feet per day; and this will be increased to 4 million cubic feet with the vertical retorts. The new method of carbonizing coal will not only result in considerable economy in the production of gas at the station, but will largely remove the nuisance from smoke and steam which has been experienced for so long in this congested neighbourhood with the old method of carbonizing.

Bradford Road.—The new gasholder, of a capacity of 10 million cubic feet, is completed, and will be put into action during the autumn. The work of constructing the tank and gasholder has been carried out in a satisfactory manner by the respective contractors entrusted with the work. Complete plant for the breaking and screening of coke has been erected, capable of dealing with the greater portion of the surplus coke produced at this station. A considerable demand for this class of material is not only becoming general throughout the country, but also

in the immediate district, and will result in an increased revenue from this product. The remodelling of Nos. 5, 6, 7, and 8 sets of carburetted water-gas plant is completed; increasing the total capacity of this section of gas-manufacturing plant from 6½ million to 8 million cubic feet per day, in addition to effecting marked savings in the manufacture of carburetted water gas.

Droylsden.—The vertical retorts continue to work satisfactorily; and though the plant is only of a nominal capacity of 500,000 cubic feet per day, the gross cost of manufacturing the gas closely approximates to the best results which can be obtained of the larger stations.

Chemical Works.—The improvements which were carried out last year have resulted in increased economy and efficiency in the manufacture of sulphuric acid and sulphate of ammonia.

Cambridge Street Depôt.—The remodelling of the premises purchased for dealing with the cleaning and repairing of the gas-cookers and gas-fires was completed during the year; and the shot-blast method of cleaning this class of gas apparatus has proved an unqualified success, and will result in a considerable saving in the cost of the work of the department.

STREET-MAINS AND LIGHTING DEPARTMENT.

The total length of mains laid to March 31, 1912, including high-pressure mains, is 958 miles and 109 yards; being an increase of 9¼ miles and 252 yards during the year. The number of public lamps within the city is 20,603, and without the city 1346—a total of 21,949. The incandescent system of lighting has been applied to all the lamps within the city, and the number of burners fixed thereto is 26,986.

Many applications have been received for a supply of high-pressure gas for shop and warehouse illumination; and the Committee are extending the mains to meet this demand. High-pressure lighting has been installed in Piccadilly, Mosley Street, St. Peter's Square, and part of Princess Street; and 60 public lamps have been fixed, ranging from 1500 to 4500 candle power each.

The Committee conclude their report by expressing their deep regret at recording the loss by death, on the 25th of October last, of Alderman Robert Gibson, J.P., who had been Chairman of the Committee for upwards of seventeen years, and also, on the 28th of May last, of Alderman Thomas Briggs, J.P., who had been Deputy-Chairman for fourteen years. Both of these gentlemen were, the Committee state, held in high esteem; and during their long terms of office they "gained an experience which was of inestimable value to their colleagues, and contributed in a marked degree to the success and development of the gas undertaking of the Corporation."

GAS CHARGES AT LEIGH (LANCS.).

Proposed Reduction for Prepayment Meter Users.

A motion which gave rise to considerable discussion at last week's meeting of the Leigh (Lancs.) Town Council was that put forward by Mr. W. Grundy, to the effect that from the 1st of July the price of gas to users of prepayment meters should be reduced by 2d., and to those having free fittings by 4d., per 1000 cubic feet.

Mr. GRUNDY, in moving the adoption of his motion, remarked that those who opposed the suggested reduction pointed out that the Gas Department were faced with an increased expenditure this year, chiefly because of the extra amount that would be required for coal and the cost of repairs to the retorts. But he argued that no member of the Gas Committee really expected that the increased expenditure would work out at anything like what had been put down in the estimates. Other points advanced against his proposal were that the prepayment meter cost 14s. more than the ordinary meter, and that the cost of collection was greater. But, taking these into consideration, the extra cost only amounted at the outside to 1·83d. per 1000 cubic feet on prepayment meters. The charge made to consumers who had free fittings was also altogether too much.

Alderman FAIRCLOUGH asked the Council to remember that twelve years ago they obtained from the Local Government Board sanction to a loan for the provision of £6000 working capital. This was paid off. But they required about £6000 to carry on the concern; and it had been the endeavour of the Committee to provide this. They had £5357 in the fund, and this would just be sufficient for a working balance. If they were to make charges on this money, he did not know where they would be, even assuming that Mr. Grundy's figures were correct. It was true that the net profit from the gas undertaking last year was £3127; but the extra expenditure for the current year came to £3074, and with certain small sums the total was brought up to £3270. Therefore, if these estimates worked out, there would be no profit at the end of the next twelve months. He hoped, however, there would be a marked reduction in the chief items, and also that the consumption of gas would increase. Were it not for the extra cost of £1670 for coal, at 2s 6d. per ton, a reduction in the price of gas would be feasible. As to users by prepayment meters, he did not think the charge made an unfair proportion above the ordinary meters. Taking twenty other towns, Leigh was lower than all but two—Manchester being 3d. and Blackburn 2d.

Mr. J. GREGORY, while admitting the necessity for having a good reserve fund for the gas undertaking, objected that it should be extracted from the poorest of the poor. These were, he said, the people who were compelled by sheer necessity to use prepayment meters. But even worse were the people who had the so-called "free fittings." His contention was that, the surplus on the working of the undertaking having been to a large extent extracted from the prepayment meter users and from the so-called "free fittings" consumers, they were the people who had the first call for a reduction in the price of gas. At present, prepayment meter users paid at the rate of 3s. 4d. and the "free fittings" consumers at 3s. 8d. per 1000 cubic feet, compared with 3s. 3d. and a discount of 3d. for the ordinary consumers.

After some further discussion, the matter was referred to the General Purposes Committee.

YORK CORPORATION AND THE GAS-WORKS.

Council Resolve to Purchase.

A Special Meeting of the York City Council was held on Monday last week for the purpose of considering the question of the purchase of the undertaking of the York United Gas Company. The LORD MAYOR (Alderman Norman Green) presided.

Alderman MEYER moved a resolution in favour of the purchase, and instructing the Town Clerk to deposit a Bill in Parliament to acquire the undertaking by agreement, or, failing agreement, by arbitration. He said the resolution was intended to place a clear issue before the ratepayers. The Corporation having instructed the Committee to obtain a suspensory clause in the Company's Bill, they ought to go farther, and make it plain that they intended to back them up by using the clause. They would be asked in the House of Commons if they intended to acquire the undertaking. The Bill had so upset the relations between the public and the Gas Company, that the question of purchase had been raised, and ought to be put before the people. No harm would be done to the Company by the acquisition of their undertaking, either by agreement or by arbitration, as adequate protection would be granted to every interest. People complained that purchase would cause a further charge on the rates. But it was as bad for the ratepayers to pay too much for their gas as to pay too much in rates; and he believed the acquisition of the gas undertaking would enable the Corporation to reduce the rates. As to the financial situation, the Company had roughly about £420,000 of capital—excluding debentures—on which they could pay a maximum dividend of 4 per cent. At the present time, the ordinary stock stood at between 90 and 91, and the preference stock a little more. The revenue last year, including income-tax, was £18,700. There was a provision in the Bill for a reduction in the illuminating power of the gas which would reduce the cost of manufacture by 1½d. per 1000 cubic feet, equivalent to a saving of £2770. Adding this to the £18,700 made £21,470. If they bought the undertaking, they might acquire it at par or even less; they would probably get 35 years allowed for the purchase; and the rate of repayment of the loan would be 5 per cent. for sinking fund, which would be equivalent to about £21,000. The income was £21,500, and would be progressive, because considerable economies would be effected. He insisted on the necessity of the Corporation preventing the continuous tearing-up of the streets by three or four different authorities, and referred to the grave danger to the densely-populated district around the works if the Company, under the pressure of the shareholders, exercised their power to manufacture residuals. The only thing between the Council and the devastation of that part of the city was the goodwill of the Directors.

Alderman TODD seconded the motion, and said he thought they would be failing in their duty if they did not give the ratepayers the opportunity of deciding the question.

The SHERIFF (Mr. J. B. Inglis) opposed the motion. He complained that when they were recently talking of acquiring the water-works, they were assured that the Gas Company would be left severely alone. He suggested that if the Corporation acquired the gas undertaking, there would be no competition between gas and electricity, and the consumers would suffer. If the resolution were carried, the result would be disastrous to the city.

Mr. RHODES BROWN suggested that the purchase of the undertaking would involve the city in an expenditure of £1,000,000 at least; and he said they would be quite unable to manage it.

After some further discussion, the motion was carried by a small majority.

STAFFORD CORPORATION GAS AND ELECTRICITY SUPPLY.

The Past Year's Results.

At the Meeting of the Stafford Town Council last Tuesday, the report of the Chairman of the Gas and Electricity Committee (Mr. C. H. Wright), accompanied by analyses of the accounts of the two departments signed by the Engineer and Manager (Mr. W. M. Valon), for the year ended the 31st of March, was presented. It furnished the following particulars.

During the year, 218,813,000 cubic feet of gas were sent out from the works, compared with 211,852,000 cubic feet for the year ended March 31, 1911; and the unaccounted-for gas was 3,475,832 cubic feet, or 1·59 per cent., being a decrease of 0·46 per cent. compared with the previous year. This is stated to be the lowest figure of any gas undertaking in the kingdom. The sales of gas yielded £25,456, an increase of £627; and residuals produced £8480, against £7620 before. Coal cost £10,539, compared with £10,090; while the working expenses were £8996, against £8752. Stove hires, less repairs, resulted in a profit of £268; and gas-fittings yielded a profit of £554.

The total revenue was £35,437, and the total expenditure £20,213; leaving a gross profit of £15,224, compared with £14,172 for the preceding year. After deducting the usual charges against the net revenue account, there was an available balance of £9050, compared with £7710. Mr. Wright called special attention to the fact that this result was a record for the undertaking; being £600 better than the previous record of two years ago, when the price of gas was 2d. per 1000 cubic feet more, which would have meant £1282 extra profit for 1911-12.

The Committee recommended that the available balance should be dealt with as follows: That £3500 should be handed over to the district fund in relief of rates; that the usual £50 should be given to the Free Library Committee; that £1750 should be carried to the credit of the carburetted water-gas installation suspense account, thus writing this account completely off the books; that £2511 should be added to the reserve fund; and that, after the payment of the usual bonus to the workmen, the balance should be carried forward. Adding the year's contribution to the rates, they will have benefited since the

undertaking was acquired by the Corporation by no less than £62,325 out of the profits of the gas undertaking.

The Committee felt that, in spite of the increased price which will have to be paid for raw materials in the future, the time had arrived when they could make a further reduction in the price of gas; and they therefore proposed that the charge for illuminating gas to both ordinary and prepayment consumers should be reduced by 2d. per 1000 cubic feet from the 1st of July next—a concession which it was estimated would cost the department £1200 during the current year.

In the Electricity Department, 587,094 Board of Trade units were sold during the year. Of this quantity, 165,971 units were sold for lighting purposes, 413,872 units for power, and 7251 units were used in the public lamps. There was, therefore, a total increase of 111,736 units, or 23·50 per cent. The revenue from all sources amounted to £5492; and the total expenditure was £2683; leaving a gross profit of £2809, compared with £2729 before. The total charges against the net revenue account came to £2170; leaving a net profit of £639, to which had to be added the amount brought forward, making an available balance of £791. From this the Committee proposed to transfer £600 to the depreciation account, the same as before; and, after deducting the bonus, to carry the balance forward.

The analyses prepared by Mr. Valon showed that the capital invested in the gas undertaking is £35,814, or at the rate of £1 18s. 6d. per ton of coal, and 3s. 4d. per 1000 cubic feet of gas sold. The gas made per ton of coal last year was 11,757 cubic feet, of which 11,424 cubic feet were sold, or 97·16 per cent. of the output. The net profit, with the addition of the balance from last year, was equal to 9s.8·718d. per ton of coal carbonized and 10 217d. per 1000 cubic feet of gas sold. The amount expended on the electricity undertaking at the close of the financial year was £17,588, or at the rate of £31 of capital outlay per kilowatt capacity. The profit on the year's working was at the rate of 0·261d. per unit sold.

In the course of the discussion arising upon the report, suggestions were made that the Committee should consider the advisability of still further reducing the price of gas; but the Chairman stated that they preferred to go cautiously, as they did not know how the coal contracts would come out. If it were possible, next year they would recommend a further reduction.

The report was submitted to the Town Council at their meeting last Tuesday. Alderman Wright, in moving its adoption, said the year covered by it had proved a record. They were now in a strong financial position, and instead of having an adverse balance at the bank, which used to be case in the past, they were possessed of a substantial credit balance. Referring to the bonus system, he said that if the men employed were skilful, and the cost of working the department decreased below a certain standard which the Committee had fixed, the men took one-fourth of the saving effected, which was due entirely to their efficiency. This year he was pleased to be able to state that the saving had been greater than ever, as a result of which the employees would have a bonus of 11 per cent. on the wages they received last year, which would be paid to them in a lump sum, and it would be appreciated. The members of the Committee were pleased to hand over this substantial amount as a just reward for faithful service. Alderman Wright then proceeded to analyze the profits of the Gas Department since the transfer of the works, and remarked that the total profit amounted to £140,393. To-day they could reckon the works as being worth from £350,000 to £400,000. As they were only owing the sum of £35,814, if they deducted this amount they were left with works worth at least £315,000, in addition to what had already been paid over in relief of the rates. This was a most satisfactory state of things. With regard to the electricity works, they were still going ahead; the sale of current having increased by £700. The Committee were congratulated upon their report, which was adopted.

COCKERMOUTH GAS UNDERTAKING.

According to the report of the Manager and Secretary of the Gas Department of the Cockermouth Urban District Council (Mr. E. D. Wootten) for the year ended the 31st of March, which was presented at the last monthly meeting of the Council, the working in the period referred to was adversely affected by the railway and coal strikes; and for the year the price of gas was 3d. per 1000 cubic feet lower than before. The revenue was consequently less by £212. Carbonizing costs were increased by £55, owing to the granting of eight-hour shifts to the stokers. The gross profit was £858, compared with £1269; and as the payments into the sinking fund and for interest amounted together to £995, there was a deficit of £137. The Gas Committee, in their report, recommended that a bonus of £5 should be given to the Manager in recognition of his services during the coal strike, which enabled the supply of gas to be maintained with practically no curtailment.

In moving the adoption of the Gas Committee's report, the Chairman (Mr. J. Fleming) said that twelve months ago he stated that the estimated reduction owing to the lower price of gas would exceed the net profits of the previous year. They then thought they might be able to go through the twelve months without a deficit; but extra expenditure was incurred by the purchase of land and the installation of a new exhauster, the cost of which was £125. Had this been charged to capital account, which might have been legitimately done, the deficit would only have been £11. The adoption of an eight-hour shift for the men had also been an additional expense; but the Committee thought this was money rightly spent. The coal strike affected them, and in consequence the cost of handling coal was greater. With regard to the proposal to give the Manager a bonus of £5 for the extra work done, some might think that this was more than they could afford; but he would like to point out that the works stood on their own bottom, and nothing of this came out of the rates. The works were now carried on at considerably less expense than they had ever been before. The report was adopted.

HOLBORN PUBLIC LIGHTING.

A Commencement with the New System.

After many tedious and vexatious delays, extending over a period of nearly three years, a definite commencement has been made with the relighting of the thoroughfares under the supervision of the Holborn Borough Council. The London County Council having agreed to the application of the Borough Council for the necessary money, and the lighting conditions between the Council and the two Companies concerned (the Gaslight and Coke Company and the Metropolitan Electric Light Company) having been agreed to, they have got to work. Considerable progress has been made by the Gas Company, who have laid a high-pressure main through the length of High Holborn and New Oxford Street, connecting with their existing high-pressure mains in the Kingsway subway which light that thoroughfare, also connecting with their high-pressure mains in the Shaftesbury Avenue subway which light that portion of the City of Westminster from their Horseferry Road power-house. Quite a large number of the 90 and 180 candle power "Nico" low-pressure burner lamps have already been installed in the area comprising the Bloomsbury squares between Euston Road and New Oxford Street, which would well repay an inspection.

The following are the streets to be lighted, and the candle power of the various lamps.

Situation and Power of Lamps.	Electric.		Gas.		Total Candle Power.
	No. of Lamps.	Columns.	No. of Lamps.	Columns.	
1800 Candles.					
High Holborn and New Oxford Street	18	18	20	20	68,400
Kingsway, High Holborn Crossing, and Southampton Row to Vernon Place	2	2	26	25	50,400
Shaftesbury Avenue	..	..	21	21	37,800
600 Candles.					
High Holborn and New Oxford Street	13	5	8	4	12,600
Tottenham Court Road	..	..	20	20	12,000
400 Candles.					
British Museum Avenue	..	..	6	6	
Brooke Market	2	1	..	..	
Chancery Lane	10	10	..	..	
Gray's Inn Road	51	51	..	..	
Theobald's Road	42	42	..	..	
Charterhouse Street	..	..	13	13	
Holborn Circus	4	4	..	..	
Farringdon Road	22	22	..	..	
Clerkenwell Road	28	28	..	..	
Hart Street	11	11	..	..	
Bloomsbury Square (south side)	7	7	..	..	
Vernon Place	1	1	..	..	
Charing Cross Road	..	..	12	12	
Great Queen Street	13	13	..	..	
Southampton Row (Vernon Place to Russell Square)	18	18	..	..	97,200
300 Candles.					
British Museum Avenue	..	..	20	10	
Rosebery Avenue	..	..	23	23	
Endell Street	1	1	..	..	
Guildford Street	..	..	1	1	
Russell Square	..	..	1	1	13,800
180 Candles.					
Bedford Place (and Russell Square corners)	..	..	12	12	
Gower Street (and Bedford Square and Montague Place corners)	..	..	16	16	
Queen Square	1	1	..	..	
Bedford Row	1	1	..	..	
By Baths, Broad Street	..	..	2	2	
,, ,, Endell Street	1	1	..	..	
By Steps, Onslow Street	1	1	..	..	
By Church, High Street	..	..	2	2	
Sardinia Street (north side)	..	..	2	2	6,840
90 Candles.					
Remaining Streets in borough	716	716	674	674	125,100
Totals	966	957	879	865	424,140

It will doubtless be remembered that the two Companies undertook to supply and maintain the various units conprising this total of 424,140 candles at £6950 per annum, *plus* an extra 10 per cent. if the Council's testing clause was insisted upon—making the total cost £7645 per annum for a period of ten years; and this was agreed to.

Reduction of Capital of the Tarapaca Water Company.

Last Wednesday week, Mr. Justice Swinfen Eady had before him a petition presented by the Tarapaca Water-Works Company, Limited, asking the Court to confirm resolutions which had been passed for reducing the capital of the Company by returning to the shareholders £2 on each share. Mr. Martelli, K.C., explained that the Company was incorporated to supply towns in Chili with water. The prosperity of these places depended upon the nitrate supplies, which were being worked out, with the result that the Company now had more capital than could be usefully employed. In 1908, some of the capital was paid back to the shareholders; and not long ago Mr. Justice Parker sanctioned the return of £80,000. The Company had ample funds in hand to meet all requirements in addition to the sum proposed to be refunded—viz., £80,000. His Lordship sanctioned the reduction.

HEBDEN BRIDGE AND MYTHOLMROYD GAS BOARD.

At the recent annual meeting of the Board, the report and balance-sheet presented showed that the gross profit amounted to £5368, from which had to be deducted the year's dividend on the 3 per cent. redeemable stock, interest on mortgage loans, the amount of instalments to the redemption and sinking funds, and a sum of £271 allocated to the repairs and renewals fund for cooking-stoves—leaving a net profit of £1324, against £1072 for the previous year. The statement of the Gas Engineer and Manager (Mr. J. Wellens) showed that the quantity of gas manufactured was 96,028,000 cubic feet, against 93,672,000 cubic feet during 1910-11. He anticipated an increase in the price of coal for the coming year of 1s. 6d. to 2s. per ton, and estimated that the recent coal strike cost the Board about £100.

The Chairman (Mr. J. Simpson, J.P.) said the gross profit was the largest since 1904, when it was £5600. Considering the price of gas (this having been reduced since 1904), the net profit of £1324 was very good. The make of gas was the largest they had had since acquiring the works. When these were taken over about seven years ago, the make per annum was 42 million cubic feet; so they had the large increase of 54 millions. More than £30,000 had been spent on the works, and now they had to commence all over again. The Manager estimated an increase of about 1s. 6d. per ton in the cost of coal during the year; but he (the Chairman) was advised that they were likely to have to pay 2s. 6d. per ton more for their next contracts, owing to insurance and the effects of the late strike.

MALTA AND MEDITERRANEAN GAS COMPANY.

An Arrangement at Trapani.

The Ordinary General Meeting of this Company was held last Tuesday, at the London Offices, Nos. 59-60, Gracechurch Street, E.C.—Colonel James Le Geyt Daniel in the chair.

The Secretary (Mr. A. W. Cooper) read the notice convening the meeting and the report of the Auditors; and the report of the Directors and the statement of accounts were taken as read.

The Chairman, in moving the adoption of the report and accounts, remarked that they spoke for themselves; and he only wished to refer to one or two points with regard to which questions might arise in the minds of the shareholders. In the year to March last, coal cost the Company £581 more than was the case in the preceding twelve months; but the quantity used was practically the same—only 5 tons more. The total amount of gas made was 132,003,000 cubic feet, which compared with 133,392,000 cubic feet for the year before. Of this, 79,108,000 cubic feet went to private consumers, and 35,035,000 cubic feet for public lamps. While coal cost £581 more, coke produced £251 more, tar and pitch £55 more, and oil used £149 less. Thus there was a sum of £455 to set against the additional outlay on coal. The cost of maintenance was £1256 less than in the previous year. Glancing at the general revenue, it would be noticed that £3000 was carried to a reserve account. As to the general balance-sheet, there was a small increase in the amortizement account, due to the interest on investments being added to it. Some explanation might be given with regard to the item of stocks at stations. This stood at £10,449, compared with £13,228—a variation which was entirely due to the stocks of coal being less. In the preceding year, they were very heavy indeed. Sundry creditors had crept up from £20,057 to £21,432. He had often referred to the trouble the Company had had with one of their Sicilian stations—Trapani. They had always had by law to supply the people there with gas; but the same law did not make them pay for the gas so received. Matters got into such an unsatisfactory condition that they occupied the very serious attention of the Board for months, and even years. Steps had, however, now been taken which it was hoped would lead to a good result. The Government had turned out the members of the Municipality at Trapani, and had appointed a Royal Commissioner. This was the very best thing that could have happened, because the Royal Commissioner was absolute. He was a Government official; and he carried on the business of the Municipality. He was the one man really; and the Board trusted he would act well towards the Company. Of his good intentions they had already had some experience. The arrangement made in connection with Trapani was very much on the same lines as that carried out at Marsala some three years ago. It had worked well at Marsala, which, however, was, of course, a smaller place. The Company were receiving their money regularly from that place; and it seemed to him to be the best arrangement that could be made. It entailed the extension of the contract for ten years from the expiration of the present one three years hence—making thirteen years in all to run. The Company had had handed to them certain securities in the shape of taxes on property which were collected by the Municipality; and they were to be paid, not only for the current consumption, but also the back debt, by regular instalments. He hoped this agreement would be carried out. Since the commencement of the year they had been paid through the Royal Commissioner £2500; and they were to receive another £1500 before the end of the year. He did not think they could have done better than this. Of course, Italy was rather under stress at the present time; but they were informed that the Municipality were quite able to carry out the arrangement made by the Royal Commissioner. An agreement had been drawn up, which had been signed by the Company and by the Commissioner; and it would now have to be laid before the new members of the Municipality, when appointed. This matter had, of course, been a source of great anxiety to the Directors; and, in connection with the negotiations, he might mention that he had himself paid a visit to the Embassy in Rome last March.

Colonel Stephenson R. Clarke seconded the motion.

Mr. H. R. Sibson said he would like to make a few observations

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and letters in its praise, and thanking us for the great service done to the Industry in introducing it. It is a wonderful welcome, but all who test the Calefactor say it deserves it.

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TEST THE CALEFACTOR.

upon the report and upon the remarks of the Chairman, especially as he (the speaker) had on one or two occasions ventilated, from the shareholders' side of the table, the question of the very heavy debt owing by the Municipality of Trapani. He thought it was only fitting that opportunity should now be taken of expressing the satisfaction of the proprietors that the Board were able to announce something in the nature of an arrangement which, so far as they could rely upon the Sicilian Municipalities, they might hope would bring them within reasonable touch of a settlement. He remembered suggesting a year or two ago the hypothecation of certain dues that might be coming to the Municipality; and he believed that the matter was taken up by the Board and Mr. Cooper, and it was intimated that this might be done. It appeared, in fact, to be very much the basis of the arrangement now announced. At any rate, it was a matter for congratulation that they could see something accomplished towards clearing off this heavy and unfair encumbrance upon the finances of the Company. Though the reports of the Company never erred in the direction of undue length, he did not think any shareholders would object to a report which announced a dividend of 6 per cent. for the year, free of income-tax; and the Directors and officials were entitled to an expression of appreciation by the shareholders of their efforts, especially in view of the anxiety that this item had undoubtedly caused them. It must have meant a great amount of worry to the Board, who might feel assured of the sympathy of the proprietors.

The resolution was then carried unanimously.

Proposed by the CHAIRMAN, and seconded by Mr. A. M. PADDON, it was agreed that the usual dividends should be paid on the first and second preference capital and a dividend of 4 per cent., free of income-tax, on the ordinary capital, making, with the interim dividend paid last December, 6 per cent. for the year—leaving a balance of £1749 to be carried forward.

The re-election as a Director of Mr. A. F. Phillips was agreed to, on the motion of the CHAIRMAN, seconded by Mr. PADDON.

Mr. PHILLIPS, in acknowledgment, said that certainly the Italian stations had caused a considerable amount of anxiety; and the work connected with them was exceedingly onerous. It was only those who had been associated with Italian businesses so many years as he had who could appreciate the difficulties that had to be contended with, and the tact and discretion which it was absolutely necessary to exercise in dealing with the men and also with the public authorities. They all endeavoured to take every possible advantage of the gas shareholder; and while they desired to have gas as cheaply as possible, they tried at the same time to defer paying for it. Therefore the Directors had continually to watch and protect the interests of the proprietors.

The Auditors (Messrs. R. Hesketh Jones and Thomas Guyatt) were then re-appointed.

Mr. F. R. SMITH, in moving a vote of thanks to the Chairman and Directors, remarked that the balance-sheet was very satisfactory.

Mr. W. RICHARDS seconded the resolution, and it was agreed to.

The CHAIRMAN, responding, expressed the hope that next year the Directors would be able to give a better account as regarded Trapani, and one as good as the present in other respects.

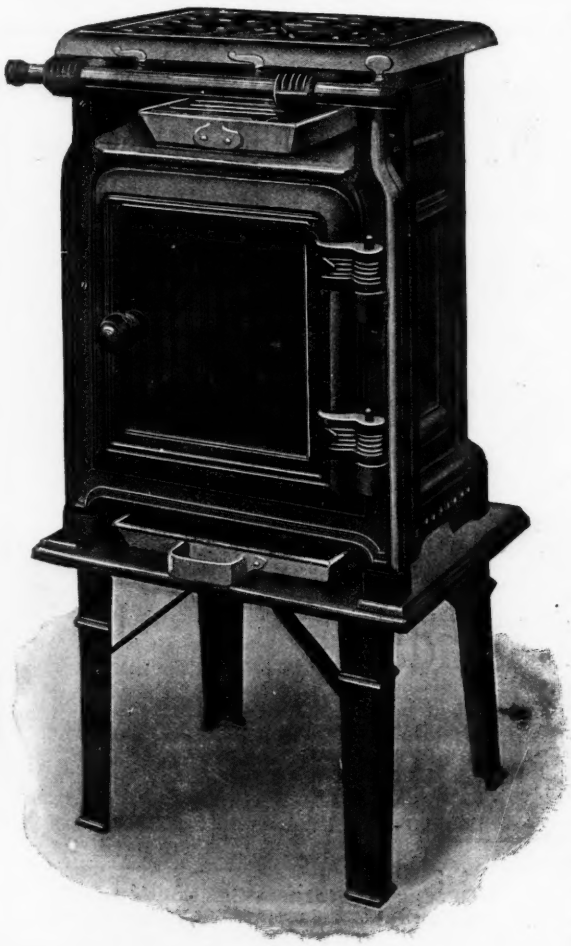
Mr. JOSEPH CASH proposed a vote of thanks to the officials. He said that the working showed remarkably good results. A comparatively large increase in profits had been obtained, under rather exceptional conditions.

Mr. SIBSON seconded the resolution, which was unanimously passed, and acknowledged by Mr. COOPER.

DEVONPORT CORPORATION GAS UNDERTAKING.

The Past Year's Working.

The Chairman of the Gas Committee of the Devonport Corporation (Alderman Tozer), in proposing the adoption of the annual report at last Thursday's meeting of the Town Council, said the statement was somewhat disappointing. They had hoped to do much better than in the previous year, but had not realized this expectation. The Committee and the Council had, however, been quite justified in reducing the price of gas, for they were still in a position to show a satisfactory net profit, though it was not so large as they had hoped for. The gross profit was £20,664, which compared rather badly with the £22,922 of the previous year; but the causes were evident. First, the reduction in the price of gas meant a loss of revenue of £2236; and then they had an additional expense of £890 through the increased cost of coal, which no one could anticipate. The rent of stoves had been reduced 50 per cent., which caused a loss to the undertaking of £176, though it was to the advantage of the users of stoves. There was also an increase of £384 in the amount required for interest on loans and their repayment. These items, 90 per cent. of which were to the consumers' advantage, made a total of £3686; so that, but for the reduction in the price of gas and in the rental of stoves, the net profit would have been £5351, as compared with £4287 for 1910-11. The loans sanctioned in connection with the gas undertaking amounted to £345,713; and the money actually borrowed was £332,894. They had repaid £55,633 and placed £25,129 in the sinking fund, which meant that £80,762 had been taken from revenue for reduction of capital since the gas-works had been under the control of the Corporation. The charge remaining on the undertaking was £252,132. During the past year, there was an increase in the sales of gas of 16,866,000 cubic feet, or 4¼ per cent. on the previous year. For lighting there was a slight decrease, but in the sales for cooking and by prepayment meters a considerable increase. Last year there had been innumerable complaints as to the quality of the gas, and it was urged that something should be done to improve it. The Committee had done this by a large increase in the use of oil, which had caused an extra expense of £500; but they were giving greater satisfaction, and the complaints were very few indeed. The quantity of gas produced per ton of coal carbonized was 10,946 cubic



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feet, compared with 10,099 cubic feet in the year 1910-11. This was a record in the history of the undertaking. The number of consumers was increasing, and was now 20,000, with 1570 stoves on hire; while ten years ago the number was only about 7000. There had been an expenditure of £1044 on new mains and services. A balance of £1645 had been placed to the reserve fund, which now amounted to £10,367. It was urged that when the undertaking had a reserve fund of £10,000 it was time for the consumers and ratepayers to reap some advantage. The Committee would be pleased to do something in this way; but they considered that with the present labour unrest and the probability of an increase in the cost of coal it would be unwise to diminish the reserve. An expenditure from this fund to provide additional facilities for transhipping coal and conveying it from the wharf to the works had been sanctioned. He did not know any undertaking where better results would be achieved if it were possible to inaugurate a system of profit-sharing among employees. If the men had some interest in the profits made, it would be not only to the interest of the employees but in that of the undertaking. In private concerns it had been tried successfully. The report was adopted.

Municipalities and Profit-Sharing.

Referring to the remarks on the subject of profit-sharing made by Alderman Tozer at the close of his speech, our Plymouth Correspondent says: Hitherto the system has been confined to businesses under private control; but there is no reason why its benefits should not be extended to municipal undertakings, if means can be found to adjust the basis on which the profit is to be divided. One reason of the great success which has attended profit-sharing in gas-works owned by companies is that the profit of any year is absolutely determined, and its relation to the advantages gained by the consumers and the shareholders by the exercise of skill and prudence in the conduct of the undertaking is placed beyond question by the operation of the sliding-scale. In municipally-owned gas-works things are different. Net revenue is not the same thing as the profit of a company, though it is commonly spoken of as profit. If profit-sharing were based on the division of the net revenue, some system would have to be devised which would take into account the interests of the consumers. In the case of companies, these are protected by the sliding-scale. Among corporations there is, however, a variety of methods, some of which rather overlook the source of the profit. Most municipal authorities consider it to be necessary to make their trading concerns produce a balance for the benefit of the ratepayers; and there are not a few instances in which the price of gas is maintained at an unnecessarily high figure in order that there may be a large surplus to place to the credit of the rate fund at the end of the year. In other cases—a minority, no doubt—gas is regarded as one of the necessities of life, and is sold at the lowest price at which it can be produced. The sharing of profit in these different circumstances could hardly be managed in the same way. There would need to be an entirely different basis from which to start; but when once this was found and established, the rest would be comparatively easy. Hope may be expressed that Alderman Tozer will succeed in inducing his Committee and the Council to give the matter a trial. Devonport is probably in as good a position as any town to carry out an experiment of the kind. The Gas Committee are not bound by custom to produce a large sum for the relief of the rates, while they have entered upon what may reasonably be expected to be an era of steady prosperity. The conditions are not unfavourable; and if the Committee work out a scheme which will benefit the men while at the same time serving the interests of the undertaking, they will find much sympathy among all who are interested in the progress of the gas industry. It is the first step which is difficult; but if Devonport shows the way, other municipalities no doubt will follow.

REGULATIONS IN REGARD TO WATER SUPPLY.

Pamphlet by the Institution of Water Engineers.

At the recent annual meeting of the Institution of Water Engineers, the President (Mr. J. S. Pickering) presented, at the request of the Council, a report on the work of the Incorporated Joint Committee on Water Regulations. It had been prepared by Mr. F. J. Bancroft, M.Inst.C.E., the Engineer and Manager of the Barnet District Gas and Water Company, one of the representatives of the Institution on the Committee, and it furnished the following information.

In the year 1908, the Joint Committee issued a model code of water regulations, attached to which were appendices containing standard specifications of various water-fittings in common use, and extracts from General Water Acts relative to the waste and misuse of public water supplies. On this occasion, the Committee were unable to guarantee that the Local Government Board would sanction the adoption of the model code by those water authorities who were dependent upon the sanction of the Board for the regulations. Several corporations and companies, who were empowered by their Private Acts to issue regulations and bye-laws independently of the Local Government Board, adopted the model code *in extenso*; while many other water authorities submitted the code to the Board for their approval—for the moment, however, without success.

The incorporation of the Joint Committee, the registration of a "standardization mark" (under regulations approved by the Board of Trade) for use on fittings constructed in accordance with the standard specifications, and conferences between representatives of the Committee and the Local Government Board officials, contributed to the strengthening of the position of the Committee, and the removal of the Board's objections to the model code. Thus in the course of last year the Board issued a revised edition of their own "Model Bye-Laws," which in many vital points showed that the recommendations of the

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Committee had been adopted. In connection with this, the Board issued a preface, in which the work of the Committee and the assistance rendered by the Institution of Water Engineers and other bodies were fully recognized; moreover, the Board clearly indicated the possibility of water authorities publishing officially, in the form of "Conditions of Supply" annexed to water regulations, such parts of the model code as could not for the moment be accepted by them as bye-laws subject to legal penalties for breach.

The Committee have now prepared in pamphlet form (1) the model bye-laws issued by the Local Government Board, (2) those issued by the Committee revised to date, and (3) supplemental conditions of supply which it is proposed should be adopted, as far as they may apply, by water authorities, and issued as an appendix to the statutory bye-laws approved by the Local Government Board. This pamphlet will shortly be supplied gratuitously to all members of the Institution in charge of water undertakings; and it is hoped that, as a result, a large number of water authorities will now adopt a uniform code of water regulations.

The Institution is represented on the Joint Committee, not only by the two delegates specifically appointed by the Council (Mr. F. J. Bancroft and Mr. Frederick Griffith), but by 15 other members appointed by their respective water authorities; so that of the 48 members of the Committee, 17, or more than 35 per cent., are members of the Institution. The Council feel every confidence, therefore, in commending the work of the Committee to all the members, and in urging them to assist as much as possible in securing uniformity of practice in so important a matter as that of water regulation for preventing the waste, undue consumption, misuse, or contamination of public water supplies.

Water Profits at Coventry.—In addition to the large profits made by the gas undertaking of the Coventry Corporation, the accounts of the Water Department show an available surplus of £6945 on the past year's working. It is proposed to deal with this as follows: To devote £4500 in relief of the rates; to pay £500 into a special fund to provide against fluctuations in the value of investments; and to carry forward the balance of £1945.

Improvements at Heywood Gas-Works.—The tender of West's Gas Improvement Company, Limited, has been accepted by the Heywood Town Council in connection with the scheme, costing £12,000, for modernizing the plant at the gas-works. Glover-West vertical retorts are included in the new equipment; the carbonizing plant being equal to 500,000 cubic feet per day, and the cost of the improvement £9000. The Gas Engineer and Manager (Mr. W. Whatmough) hopes to have the work completed by October. In addition to the £9000, there is an estimated expenditure of £500 for work in connection with the gas, water, and steam-pipes, and the alteration of the retort-house; and other expenditure to be provided for out of the loan applied for consists of £1500 for prepayment meters and £1000 for mains.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Edinburgh.

At a meeting of the Edinburgh and Leith Corporations' Gas Commissioners on Monday, tenders, distributed among a number of contractors, for a supply of coal for the Granton Gas-Works as from July 1 next to July 1, 1913, were accepted. The quantity specified was 150,000 tons; and the price was 11s. 10d. per ton—an increase of 2s. 2½d. per ton over the figure of last year. Altogether, eighteen different kinds of coal were contracted for.

The proposal by the Edinburgh and District Water Trust to provide three sand filters at Fairmilehead at an estimated cost of £16,500 has been deferred, in order that certain points in the figures might be gone into before a definite conclusion was arrived at.

Arbroath.—At a meeting of the Gas Committee, the Manager submitted his report for the year to May 15. The gas manufactured during the year amounted to 110,622,000 cubic feet—an increase of 7,105,100 cubic feet over the previous year. The quantity sold was 101,695,462 cubic feet; while the amount in 1910-11 was 95,842,489 cubic feet—increase 5,852,973 cubic feet. The gas sold to ordinary consumers in 1911-12 was 62,126,012 cubic feet; in 1910-11, 59,491,589 cubic feet—showing an increase of 2,634,423 cubic feet. The gas sold to slot-meter consumers in 1911-12 was 36,615,050 cubic feet; in 1910-11, 33,433,100 cubic feet—an increase of 3,181,950 cubic feet. The gas sold to gas-engine proprietors in 1911-12 was 2,954,400; in 1910-11, 2,917,800 cubic feet—an increase of 36,600 cubic feet. The total amount received for gas sold through ordinary meters, coin meters, and for gas-engines during the year amounted to £13,330 19s. 1½d.; while the amount in 1910-11 was £13,650 0s. 7½d.—showing a decrease of £319 1s. 6d. Allowing for gas used on the works, &c., there remained 6,121,954 cubic feet unaccounted for, equal to 5·53 per cent. It appeared that the result of the increased price of coal would represent an addition of about £1100 in the cost for the current year; but a considerable proportion of this would be recovered from the enhanced price to be received for the tar and sulphate of ammonia sold. It was pointed out that the decrease in the receipts for gas sold was accounted for by the reduced price of gas.

Brechin.—On Monday, the Town Council agreed, subject to the ultimate confirmation of their resolution, to adopt the Burgh Gas Supply Act, and to offer the Brechin Gas Company the sum of £30,000 for their undertaking, including works, plant, goodwill, &c.

Cullen.—Mr. Lewis Bain, of the Fraserburgh Town Council Gas Department, who has had charge of the distribution section for the past few years, has been unanimously appointed Manager of the new Cullen District Gas Company.

Crossgates.—About midday on Saturday, when John Walker, the

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Old Broad Street,
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LEST YE FORGET.

caretaker of the Masonic Hall, was entering the lower room of the hall he found that one of the burners had been left turned on, and that there was a strong smell of gas. He turned off the gas, and left the hall with the door open to allow the air to be purified. On returning about half an hour later, accompanied by a man named Moore, Walker struck a match, when immediately an explosion took place which resulted in rather serious injuries to the caretaker. Moore was only slightly burned about the face.

Dunfermline.—After prolonged negotiation and discussion, the Dunfermline Town Council have resolved unanimously to proceed with the laying of a high-pressure gas-main to supply light and power to Culross and the intermediate villages. The rate proposed to be charged is 4s. per 1000 cubic feet, which will wipe off the capital cost of the pipe in fifteen years. It is estimated the work will cost £4000. The Town Council have agreed to increase the wages paid to plumbers in the Gas Department by 2s. per week, and that of labourers to 5½d. per hour.

Innellan.—A meeting of the Innellan Special Lighting Committee was held in the Royal Hotel—County Councillor Duncan Lamont presiding. The Chairman reported that, after further correspondence with the Dunoon Gas Committee, a letter had been received intimating that they had agreed to lay the necessary mains for Knockamillie Road, extending from the shore to the end of Irvine Terrace. This will now enable the Innellan Committee to carry out the complete new lighting scheme.

Monifieth.—The Lighting Inspector reported to the Town Council on Tuesday that during the season four new lamps had been erected. A comparison of the amount of gas consumed during the past two years showed that it had increased by 468,400 cubic feet.

Peebles.—At the monthly meeting of the Town Council on Monday, it was agreed, on the recommendation of the Gas Committee, that the Manager's salary be increased to £250, and that the workers receive an increase in their weekly wages—retort men of 3s., yard men of 2s., and that their bonus at the end of the year be reduced.

Reconstruction of the Widnes Gas-Works.—In accordance with instructions given a month ago, Mr. Isaac Carr, the Gas Engineer of the Widnes Corporation, has presented to the Widnes Town Council his scheme for the reconstruction of the gas-works, at an estimated expenditure of £30,000. The broad details of the scheme, which comprises much construction in proportion to extension, show that the capacity of the proposed carbonizing plant is 2,500,000 cubic feet per day, compared with 2,200,000 cubic feet, the capacity of the existing equipment; and it will be laid down so as easily to lend itself to an increase up to 4 million cubic feet. Storage is provided for 9000 tons of coal, compared with the present storage of 3000 tons. Mr. Carr estimates that a saving of £8000 per annum will result from the changes proposed, and that even the present low prices of gas will be capable of reduction.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 15.

Sulphate of Ammonia.

The market has been somewhat irregular, and in some cases less than quoted prices have been accepted in order to effect sales. There has been rather more demand, but, on the other hand, supplies have been more abundant, and on the whole values at the close are barely equal to those a week ago. The closing quotations are £14 12s. 6d. per ton f.o.b. Hull, £14 13s. 9d. per ton f.o.b. Liverpool, and £14 12s. 6d. per ton f.o.b. Leith. There continues to be good inquiry in the forward position, but the firmness of makers checks business, and orders taken abroad must have for the most part been done speculatively at below makers' prices.

Nitrate of Soda.

This article remains steady on spot; the quotations being 11s. per cwt. for 95 per cent. and 11s. 1½d. for refined quality.

LONDON, *June* 17.

Tar Products.

The markets for tar products remain very firm. Pitch maintains its price, though the business doing is for near delivery. There is a fair amount of inquiry for forward; but prices are so high that business is not possible at the moment. Benzols maintain their price, and fair figures are being paid for prompt delivery. Solvent naphtha is in good demand, and fair prices have been paid. Heavy naphtha also maintains its price. In crude carbolic acid, it is very difficult to do business at the moment. A fair amount of business has been done in creosote during the week, and further increase in price is reported.

The average values during the week were: Tar, 29s. 3d. to 33s. 3d. *ex* works. Pitch, London, 53s. to 54s. 6d.; east coast, 52s. 6d. to 54s. 6d.; west coast, Clyde 53s. to 54s. 6d., Manchester 51s. to 53s. 6d., Liverpool 52s. 6d. to 53s. 6d. Benzol, 90 per cent., naked, London, 11d. to 11½d.; North, 11d.; 50-90 per cent., naked, London, 10d.; North, 9½d. Toluol, naked, London, 10½d.; North, 10d. Crude naphtha, in bulk, London, 4¾d. to 5¼d.; North, 10d. to 10½d. Solvent naphtha, naked, London, 1s. 1d. to 1s. 1½d. f.o.b.; North, 11½d. to 1s. f.o.b. Heavy naphtha, naked, London, 11d. to 1s. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 3d.; North, salty, 2⅝d. to 2¾d.; liquid, 3d. to 3¼d. Heavy oils, in bulk, 3¼d. to 3⅜d. Carbolic acid, casks included, 60 per cent., east and west coast, 2s. 5d. to 2s. 6d. Naphthalene, £4 10s. to £10; salts, 45s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

Sulphate of Ammonia.

There is practically no alteration in the value of this product; and though there is not very much business doing for near delivery, there

CARRON

PLACE this season's order for cookers now. Do it right away—*CARRON* make, of course. *CARRON* stands for quality, design, and service. Your consumers will ask for *CARRON*, as a matter of course; but should they omit to specify, give them *CARRON*—for their satisfaction and your credit.

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is a fair amount of inquiry for forward. Outside London makes are quoted £13 17s. 6d.; Hull is £14 12s. 6d. to £14 13s. 9d.; Liverpool, £14 15s. to £14 16s. 3d.; Leith, £14 15s.; and Middlesbrough, £14 13s. 9d.

COAL TRADE REPORTS.

Northern Coal Trade.

Though there has been some interference with the coal trade through stoppages at southern ports, the general tendency is fairly good for this season of the year. In the steam coal trade, best Northumbrians are in fair demand at about 12s. 6d. per ton f.o.b.; second-class steams are 11s., and steam smalls are steady from about 9s. to 9s. 6d. The production is full, and on the whole it is well taken up. In the gas coal trade, there have been some stoppages of cargoes for the Thames, which have forced up the rates of freight. Best Durham gas coals are from 13s. 3d. per ton f.o.b.; and seconds are about 11s. 6d. per ton. "Wear" specials may be quoted at 14s. per ton f.o.b. As to contracts for gas coal, a number have been settled for small quantities—to Genoa, at 24s., at that Italian port; to Jonköping, at 13s. per ton f.o.b.; and to a French port, at a similar figure. Two of the largest of the local contracts for gas coal are now in treaty—namely, for Newcastle and for Sunderland; and these are expected to be settled next week at rates that will show advances on those of the expiring contracts. Coke is firm. Gas coke seems quiet, with the price from 17s. 9d. per ton f.o.b. At some of the inland gas-works, coke is now in fuller stock.

Scotch Coal Trade.

During the week, the coal trade throughout Scotland has become steadier, and prices show a slight upward tendency. There is a strong demand for export, and the tonnage is pretty evenly distributed. On Friday, the following were the f.o.b. prices in Glasgow: Steam coal, 10s. 6d. to 11s.; splint, 11s. 3d. to 11s. 9d.; ell, 10s. 6d. to 11s.; trebles, 10s. 9d. to 11s.; doubles, 10s. 6d. to 10s. 9d.; and singles, 10s. 9d. to 11s. 3d. In the Lothians, the collieries were most fully employed during the week.

The Salford Corporation Gas Committee have contributed five guineas to the fund established for the purpose of an appreciative tribute to Mr. Stephen Holman, the well-known inventor in connection with gas-making appliances.

The Heat Distributor Company, Limited, with a capital of £500, in £1 shares, has been formed to carry on the business of dealers in, factors of, and agents for, baking, cooking, and heat-distributing utensils and appliances, founders, engineers, &c., and to acquire the use of the term "Gas-Stove Specialists" from the owner of the copyright thereof. Among the subscribers is Mr. R. G. Marks, of Southport, "gas-stove specialist," who is down for six shares. The registered office is at Bolton.

Increased Water Storage for London.

The report of the Works and Stores Committee of the Metropolitan Water Board, with reference to the future water supply of the Metropolis, which has recently been noticed in the "JOURNAL" [see *ante*, pp. 662, 739], was considered at the meeting of the Board on Friday. The Board have power to construct three additional reservoirs—one at Stanwell, another at Littleton, and the third near Penton Hook; and the Committee recommended them to undertake the construction of the Littleton and Penton Hook reservoirs, each capable of containing 3500 million gallons of water, and 15 acres of filter-beds, at a cost of approximately £1,646,400, spread over a period of five or six years. The recommendation was agreed to.

High-Pressure Gas Lighting in Airdrie.

The first installation of high-pressure gas in the burgh of Airdrie was introduced a few weeks ago into a draper's shop in the centre of the town. The installation consists of seven 300 and two 150 candle power lamps for inside lighting, and one 1000-candle power outdoor lamp—a total of 3400-candle power. The consumption of gas for the complete installation is 5625 cubic feet, which works out at 1·6875d. per hour. The plant used is a Bryan-Donkin booster, which was installed in the works in 1909 for boosting to a low-lying district in the town. After several alterations to the governor, the pressure was raised from ½ lb. to 3 lbs. per square inch, which enables the Gas Department to supply high pressure on the route of the special main that was laid to the district. Needless to say, this first installation in Airdrie has caused quite a sensation, and several inquiries have been made regarding it. The Gas Department expect a rush for high-pressure gas before the lighting season commences.

Water Charges at Liskeard.—Attention was directed, at a meeting of the Liskeard Town Council last week, to the question of the charge made for the supply of water to shops. It was stated that since the Corporation acquired the works in 1897, the charges had been considerably increased; and a case was quoted where £20 9s. was being paid now, as compared with £12 14s. 4d. charged by the Company. The practice of the Company was to charge business premises on the ordinary scale up to a rateable value of £20 per annum, and one-fourth of the scale for any value in excess of £20; while the Council's charge is based on the full rateable value. As the Corporation are now making a profit on the undertaking, it was suggested that the old practice should be reverted to; and it was decided to memorialize the Corporation in this sense. Alderman Harwood, who was present at the meeting, said the explanation of the Company's lower charges was to be found in the fact that they bargained with people who had other sources of supply, and offered concessions to induce them to take the Company's service.

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"GASAPPARATUS LONDON."
"GASTOVES WARRINGTON."

Changes at the Warrington Gas-Works.—Hitherto the works and office departments of the Warrington Corporation Gas-Works have been under separate management; but we learn that the Gas Committee are now proposing to place the entire charge of the undertaking in the hands of Mr. W. S. Haddock, the Engineer, who will be appointed General Manager, and will have complete control of the department, and be held responsible for its proper working. A Sub-Committee has been appointed to report upon the administration of the gas undertaking.

Gas-Works Site Abandoned at Nottingham.—An extensive estate at Bulwell, on the western side of Nottingham, was purchased some time ago by the Nottingham Corporation from Mr. Albert Ball, the present Chairman of the Gas Committee, for the purpose of its utilization partly as a public pleasure-ground and as a central site for manufacturing and distributing gas. It was announced at the last meeting of the Council, however, that the scheme as to the new gas-works had been entirely abandoned, and the disposal of the surplus land was recommended to the consideration of the Public Parks Committee.

Northampton Council and the Gas-Works.—In moving, at the June meeting of the Northampton Town Council, that a Committee be appointed "to consider the acquisition and control of the local gas monopoly," Mr. Kirby said that in the United Kingdom there were 293 gas-works in the hands of corporations, against 401 owned by companies. The municipal gas-works presented an "unbroken record of success." As an instance, he quoted Leicester, where, he said, there was a net profit of £36,000 last year, and the price of gas was 2s. 4d. per 1000 cubic feet. A member, however, reminded him that the charge in Northampton was only about 2s. net—2s. 3d. per 1000 cubic feet, with 10 per cent. discount. Mr. Kirby then went on to claim that if the Northampton Gas-Works were owned by the Corporation gas could be sold at 1s. 9d. per 1000 feet, and there would still be a surplus profit. The resolution was lost.

Competitive Trials of Public Lighting at Doncaster.—Much local interest is being taken in the competitive lighting scheme now under trial for the illumination of Doncaster. At last week's meeting of the Corporation, the Gas Committee reported having inspected the lighting. They then had from the Gas and Electrical Engineers (Mr. Robert Watson and Mr. E. S. Rayner) particulars as to the cost of lighting per lamp and per 100 yards of street by gas and electricity respectively. They recommended that the two Engineers should meet again and test together the power of lighting by gas and electricity with each of the two instruments already used, and report the result in due course. Up to the present, the lighting of the Doncaster streets has been almost wholly in the hands of the Gas Committee. In the present experiment, they have installed the high-power low-pressure system in one street, under which the lamps are lighted by the existing pressure. In another thoroughfare they have adopted the Keith high-pressure system. The Electricity Department are using, alternately, arc lamps with high candle power incandescent lamps.

Shrewsbury Water Supply.—In the presence of the Mayor and members of the Shrewsbury Corporation, on Monday last week, Lord Barnard started the new engines and pumps which have been installed at the water-works, at a cost approximating £4000. This brings to a completion the scheme for giving to the town an adequate supply of water for drinking and other household purposes. Alderman Morris, the Chairman of the Water Committee, alluded to the many years the problem of the water supply of the borough had occupied the attention of the Council, and to the vast improvements which have been effected. Lord Barnard congratulated the town upon now having a pure and ample supply. Alderman Morris was presented with a solid silver salver as a memento of the great services he had rendered to the town as Chairman of the Water Committee.

Burst Water-Main at Gravelly Hill.—There was a destructive burst of a water-main shortly after seven o'clock on the morning of the 2nd inst., on Salford Bridge, Gravelly Hill. The main in question conveys the water from the Whitacre reservoirs to Birmingham, and, in conjunction with another large main from Minworth, supplies a large area on the eastern side of the city. The pipes are 36 inches diameter. The burst occurred on the main road from the city, and on the bridge which spans the Birmingham and Fazeley Canal and the River Tame. Had it taken place a few yards farther up towards Gravelly Hill, much of the water would have found its way into the canal and river; but from where the main burst the road slopes gently towards town, and a great volume of water rushed along the thoroughfare, and flooded shops, dwelling-houses, warehouses, and other buildings in an incredibly short space of time. Extraordinary scenes followed. The water in the immediate neighbourhood was obliged to be cut off; but it was restored throughout the whole district the following evening.

Uncertified Water Supply.—At the Woking Petty Sessions on the 25th ult., the Surrey County Council were summoned by the Guildford Rural District Council for having allowed a house at Liddington Farm, Worplesdon, to be occupied without having obtained a water certificate. The house was provided for a small holder. Mr. Cullerne, who appeared for the prosecution, stated that a water certificate was applied for last December; but the Medical Officer of Health, on analyzing the water, found that it was unfit for drinking purposes. The certificate was refused, and in January, after certain things had been done to the well, a further sample was taken and analyzed. This was found worse than the first. Mr. R. A. Hodges, who appeared for the defence, said he was not aware that a certificate as to water supply would be required, and possession was given to the tenant on the distinct understanding that he would fetch his water from Liddington Farm, 270 yards from the cottage. The Rural District Council allowed another person to go 216 yards for his water, but refused the County Council a certificate when their tenant had to go 270 yards. The County Council had erected forty cottages for small holders; and in all these cases a water certificate had not been obtained. The Bench fined the County Council 40s. and costs.

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Nelson and Vertical Retorts.—The sanction of the Local Government Board has been given to the application of the Nelson Corporation for a loan as follows, in connection with the improvement of the gas-works by the introduction of Glover-West vertical retorts: £4200 for retorts, £11,325 for retort-benches, coal and coke breaking and other machinery, and engines; and £5700 for building work, alterations to mains, &c.

Gas Profits at Hindley.—At the monthly meeting of the Hindley Urban District Council last Tuesday, the annual report of the Gas Manager (Mr. H. O. Timmins) was presented and approved. The gross profit represents 6·53 per cent. interest on the capital invested. The net profit was £1178; and the report set out that had two items of £471 and £415 respectively been debited against capital, and legitimately so, the net profit would have been about £2064.

Brighouse Water Supply.—An important development has just been made in connection with the public water supply of Brighouse, by the opening of a new water-tank at Hove Edge. The tank, which is constructed of reinforced concrete, has a storage capacity of 176,550 gallons, providing a supply for twelve hours in case of accident to the ordinary service; and the cost has been £1267. The opening ceremony was performed by Mr. James Bottomley, the Chairman of the Water Committee of the Corporation.

Fylde Water Board's Increased Income.—The annual balance-sheet of the Fylde Water Board shows that the income for the past financial year was £69,378, compared with £67,944 for the previous twelve months. The expenditure totalled £16,368, against £18,646; leaving a net balance of £53,010—an increase of £3713 on the balance at March 31, 1911. This balance, and a sum of £43,071 brought forward from the previous year and £430 bank interest, make the total on the revenue side of the balance-sheet £96,512. Dividend on stock absorbed £15,458, interest on loans £17,153, income-tax £1033, contribution to the redemption and sinking funds £17,417, and contribution to the capital account with respect to the purchase of land £1095, making the total charges £52,158; thus leaving a net balance of £44,354 at March 31 last.

Bradford Water-Works Finances.—The balance-sheet of the Bradford Corporation Water Department for the year ended March 31 was presented by the City Treasurer (Mr. F. Ogden Whiteley) at a meeting of the Bradford Water Committee last Wednesday. The profit for the year was £15,387, against £20,499 for 1910-11; the reduction being probably fully accounted for by the necessary restriction of supplies during the drought of last summer. The income from the sale of water for trade purposes showed a decrease of £3024. The gross profits were £150,321, and interest and sinking fund charges amounted to £134,934—there having been an increase of £3400 in respect of the new works being carried out in the Nidd Valley—leaving a net profit of £15,387. The unappropriated surplus at the commencement of the year was £22,030, from which £13,000 was applied in relief of rates—leaving a balance of £9030. This, added to the profit for the year, made a surplus on March 31 last of £24,417.

The Heywood Town Council have approved of the recommendation of the Gas Committee that the department should undertake the free maintenance of incandescent burners (labour only) upon application during the next twelve months.

According to the "Financial News," it has been definitely decided by the Committee of the Corporation of London concerned in the matter to report against the exercise of the Corporation's option to purchase the undertaking of the City of London Electric Lighting Company in 1914.

On the charge of assaulting Mr. George Pollitt, an inspector in the Gas Department of the Bury Corporation, a man named William Mahon was, at the local Police Court last Thursday, fined 10s. and costs. Defendant owed the Corporation 12s 4d. in respect of the rent of a gas-stove; and as the amount had been owing a long time, the inspector was sent to cut the gas off. It was then that the defendant assaulted the inspector with his fists.

At the last monthly meeting of the Accrington District Gas and Water Board, contracts for coal were opened and examined. These showed a very considerable increase in price as compared with last year. In fact, it is reported that the members were considerably surprised to find that the increase all round was 20 to 25 per cent. The Board postponed the consideration of the contracts, and gave authority to a small Sub-Committee to purchase spot lots on such terms as might seem to them reasonable.

A special meeting of the River Dee Fishery Board has been held at Chester to consider proposed arrangements between the Board and the Chester Corporation with regard to the hydro-electricity works on the site of the old Dee Mills. An agreement was approved of, under which the Corporation will pay £500 to the Fishery Board for the construction of works to facilitate the passage of fish over the weir; and a penalty is provided if at any time the Council should lower the water below the standard level.

Negotiations are pending between the Silloth Committee of the Holme Cultram Urban District Council and the North British Railway Company for the purchase by the Council of the gas-works at Silloth for £2400; one of the conditions being that the Company shall take 800,000 cubic feet of gas per annum for five years, at not more than 4s. 2d. per 1000 cubic feet for any period during which the charge to the general public is not below 5s., and a proportionately less rate when the charge is below this figure.

An attractive exhibition of gas appliances is being held in the Palace Rink, Oldham Road, Rochdale, under the auspices of the Gas Department of the Rochdale Corporation. Three firms are exhibiting—Messrs. Fletcher, Russell, and Co., the Richmond Gas Stove and Meter Company, and Messrs. John Wright and Co.—and on their large stands are to be found a great variety of appliances for the utilization of gas as a heating power. Cookery lectures and paper-bag cookery demonstrations, given by Miss Jennie Barker, are attracting large audiences. The exhibition will remain open till next Friday.

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The general condition of affairs on the Stock Exchange was certainly an improvement on the state of things the week before. It would indeed have been too cruel a fate to have a continuation of that for two weeks running. The two best factors were the lightening of the heavy speculative accounts which had been brooding over the House and the utter failure of the national strike so grandiloquently declared by the Sim Tappertits of our deluded operatives. Railways were thus encouraged to advance. But the premier security of England continued quite out of favour, and lost a little more ground. The Foreign Market was not a prey to agitation. The opening day was very quiet and sluggish, and things were disposed to droop from inanition. Government issues were dull, and Rails were shy at first, though they mended a little on taking brighter views of labour pacification. Americans began a weak week for them. Tuesday was quiet, preparing for the settlement, and the tone was dull. Consols lost ¼ for money and the account. Rails were less bright. There was a better tendency on Wednesday; the settlement being contemplated without much misgiving. Rails improved their figures, and Consols recovered ⅛. Thursday was quiet; but the tone was pretty good. Consols were steady, and Rails were stronger, though the closing prices were below the best. Friday was quiet and contented with the assurance that the settlement was safe. Government issues were a little apprehensive of dearer money, but Consols did not move. Rails rose as a tribute to the obsequies of the still-born strike. Saturday was a very quiet day, with a comfortable feeling generally. Consols closed unchanged at 76¼-76½—a fall of ⅛ in the week. The Money Market opened easy, but soon hardened steadily, and rates closed firm. Business in the Gas Market was not particularly good from any point of view. The volume of transactions was down to very low proportions. Comparatively few issues were dealt in, and they not much. And the tendency was not so uniformly strong as what may be regarded as the normal conditions of the market. In Gaslight and Coke issues, the ordinary was extremely quiet for it, and suffered to a slight extent from the neglect. Transactions ranged from 103⅜ to 104⅛—only a small fraction below the range of the week before; but the quotation was marked ⅜ lower. In the secured issues, the maximum realized 86½, the preference 102 and 103½, and the debenture 79 and 80 *cum div.* A few dealings only were marked in South Metropolitan, at figures ranging from 118¼ to 119¾; and the quotation was put down a point. In Commercials, there was only one bargain at 108¾ for the 4 per cent. Among the Suburban and Provincial group, Brighton ordinary was done at 157½, British at 45⅜, Bromley "A" at 132, ditto "B" at 101, and Portsea "C" at 128½. In the Continental companies, Imperial changed hands at 183 to 185½, Union at 83½ to 85, and European at 19½ and 19¾. Among the undertakings of the remoter world, Monte Video marked 11½ and 11¾, Primitiva from 7 1/16 to 7¼, ditto Preference at 5¼ and 5 5/16, and San Paulo at 11⅝.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Apl. 12	5	Alliance & Dublin Ord.	73—78	+1	6 8 2
374,000	Stk.	Jan. 12	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
250,000	5	Apl. 12	7½	Bombay, Ltd.	6—6½	..	5 15 5
50,000	10	Feb. 29	15	Bourne-mouth Gas & Water) 10 p.c. B 7 p.c. Pref. 6 p.c.	16—16½ / 14¼—14½	..	4 4 10 / 4 1 4
332,000	10	,,	7	Brentford Consolidated	258—263	..	4 18 10
330,000	,,	,,	10	Do. New	196—201	..	4 19 6
60,300	,,	,,	5	Do. 5 p.c. Pref.	118—120	..	4 3 4
206,250	,,	June 14	4	Do. 4 p.c. Deb.	95—97*	..	4 2 6
219,055	Stk.	Feb. 29	11	Brighton & Hove Orig.	215—220	..	5 0 0
244,200	,,	,,	8	Do. A Ord. Stk.	156—159	..	5 0 8
490,000	20	Mar. 28	12½	British	44½—45½	..	5 9 11
120,000	Stk.	Dec. 29	4	Do. 4 p.c. Deb. Stk.	93—95	..	4 4 3
109,000	,,	Feb. 15	6	Bromley, A 5 p.c.	128—133	..	4 10 3
165,700	,,	,,	4½	Do. B 3½ p.c.	98—101	..	4 9 1
82,278	,,	,,	5½	Do. C 5 p.c.	117—120	..	4 11 8
55,000	,,	Dec. 29	3½	Do. 3½ p.c. Deb.	80—82	..	4 5 4
250,000	Stk.	,,	4	Buenos Ayres 4 p.c. Deb.	95—97	..	4 2 6
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4—5	..	—
100,000	Stk.	Dec. 29	4½	Do. 4½ p.c. Deb. Stk.	76—80	..	5 12 6
157,150	Stk.	Feb. 15	5	Chester 5 p.c. Ord.	110—112	..	4 9 3
1,513,280	Stk.	Feb. 29	5/9/4	Commercial 4 p.c. Stk.	108—110	..	4 19 4
560,000	,,	,,	5½	Do. 3½ p.c. do.	103—105	..	5 1 6
475,000	,,	June 14	3	Do. 3 p.c. Deb. Stk.	73—75*	—½	4 0 0
800,000	Stk.	May 31	4	Continental Union, Ltd.	82—85	..	4 14 2
200,000	,,	,,	7	Do. 7 p.c. Pref.	133—135	..	5 3 8
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	,,	—	4	Do. Deb. Stk.	104—105	..	3 16 2
840,150	10	Jan. 31	10	European, Ltd.	19½—20½	..	4 17 7
16,160,600	Stk.	Feb. 15	4/14/8	Gas-light and Coke) 4 p.c. Ord. 3½ p.c. max. 4 p.c. Con. Pref. 3 p.c. Con. Deb.	103⅝—104⅝ / 84½—86½ / 102—104 / 76½—77½*	—⅝ / .. / .. / —½	4 10 2 / 4 0 11 / 3 16 11 / 3 17 5
2,600,000	,,	,,	3½				
4,062,235	,,	,,	4				
4,531,705	,,	June 14	3				
258,740	Stk.	Mar. 14	5	Hastings & St. L. 3½ p.c.	93—95	..	5 5 3
82,500	,,	,,	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Apl. 26	11	Hongkong & China, Ltd.	16½—17	..	6 9 5
131,000	Stk.	Mar. 14	7½	Ilford A and C	155—158	..	4 14 11
65,780	,,	,,	6	Do. B	123—125	..	4 16 0
65,500	,,	Dec. 29	4	Do. 4 p.c. Deb.	93—95	..	4 4 3
4,940,060	Stk.	May 15	9	Imperial Continental	183—187	..	4 16 3
1,235,000	Stk.	Feb. 15	3½	Do. 3½ p.c. Deb. Red.	88—90	..	3 17 9
200,242	Stk.	Mar. 14	6	Lea Bridge Ord. 5 p.c.	125—129	..	4 13 0
561,000	Stk.	Feb. 29	10	Liverpool United A.	219½—221½	..	4 10 3
718,100	,,	,,	7	Do. B.	158—160	..	4 7 6
306,083	,,	Dec. 29	4	Do. Deb. Stk.	100—102	..	3 18 5
75,000	5	June 14	6	Malta & Mediterranean	4⅜—4¾*	..	6 3 1
560,000	100	Apl. 1	5	Met. of 5 p.c. Deb.	100—102	..	4 18 0
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	101—103	..	4 7 5
541,920	20	May 31	3½	Monte Video, Ltd.	11½—12	..	5 16 8
1,775,892	Stk.	Feb. 15	4½	Newc'tle&G'tesh'd Con.	99—101	..	4 6 8
529,705	Stk.	Dec. 29	3½	Do. 3½ p.c. Deb.	86—88	..	3 19 7
55,940	10	Feb. 29	7/7/0	North Middlesex 7 p.c.	14—15	..	4 18 0
300,000	Stk.	May 15	8	Oriental, Ltd.	134—136	..	5 17 8
60,900	5	Mar. 14	8	Ottoman, Ltd.	7—7½	..	5 6 8
31,800	53	Feb. 29	13	Portsea Island A	137—140	..	4 18 4
60,000	50	,,	13	Do. B	130—133	..	4 17 9
100,000	50	,,	12	Do. C	127—130	..	4 12 4
398,490	5	May 15	8	Primitiva Ord.	7—7¼	..	5 10 4
796,980	5	Dec. 29	5	Do. 5 p.c. Pref.	5⅛—5⅝	..	4 13 0
488,900	100	June 1	4	Do. 4 p.c. Deb.	96—98	+1	4 1 8
312,650	Stk.	Dec. 29	4	River Plate 4 p.c. Deb.	95—97	..	4 2 6
275,000	5	Apl. 12	12	San Paulo, Ltd.	11⅛—11⅜	..	5 2 2
150,000	10	,,	6	Do. 6 p.c. Pref.	11⅞—12⅛	..	4 18 0
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.	50—51	..	4 18 0
135,000	Stk.	Mar. 14	10	Sheffield A	235—237	..	4 4 5
209,984	,,	,,	10	Do. B	234—236	..	4 4 9
523,500	,,	,,	10	Do. C	234—236	..	4 4 9
50,000	10	May 31	7½	South African	8—9	+½	8 6 8
6,429,805	Stk.	Feb. 15	5/9/4	South Met., 4 p.c. Ord.	118—120	—1	4 11 0
1,895,445	,,	Jan. 12	3	Do. 3 p.c. Deb.	78—80	..	3 15 0
209,820	Stk.	Feb. 29	8½	South Shields Con. Stk.	155—158	..	5 7 7
605,000	Stk.	Feb. 15	5/16/8	S'th Suburb'n Ord. 5 p.c.	122—124	..	4 14 0
60,000	,,	,,	5	Do. 5 p.c. Pref.	117—120	..	4 3 4
117,058	,,	Jan. 12	5	Do. 5 p.c. Deb. Stk.	120—122	..	4 2 0
502,310	Stk.	May 15	5	Southampton Ord.	105—107	..	4 13 6
120,000	Stk.	Feb. 15	7½	Tottenham A 5 p.c. and B 3½ p.c.	144—147 / 116½—118½	.. / +½	4 17 0 / 4 14 11
483,940	,,	,,	5⅝				
149,470	,,	Dec. 29	4	Edmonton 4 p.c. Deb.	96—98	..	4 1 8
182,380	10	June 15	5	Tuscan, Ltd.	8½—8⅝*	..	5 15 11
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.	99—101	..	4 19 0
236,476	Stk.	Feb. 29	5	Tynemouth, 5 p.c. max.	112—114	..	4 7 2
255,636	Stk.	,,	6½	Wands-worth B 3½ p.c. 3 p.c. Deb. Stk.	141—144 / 71½—73½	.. / ..	4 15 6 / 4 1 8
85,766	,,	Dec. 29	3				

Prices Marked * are "Ex Div."